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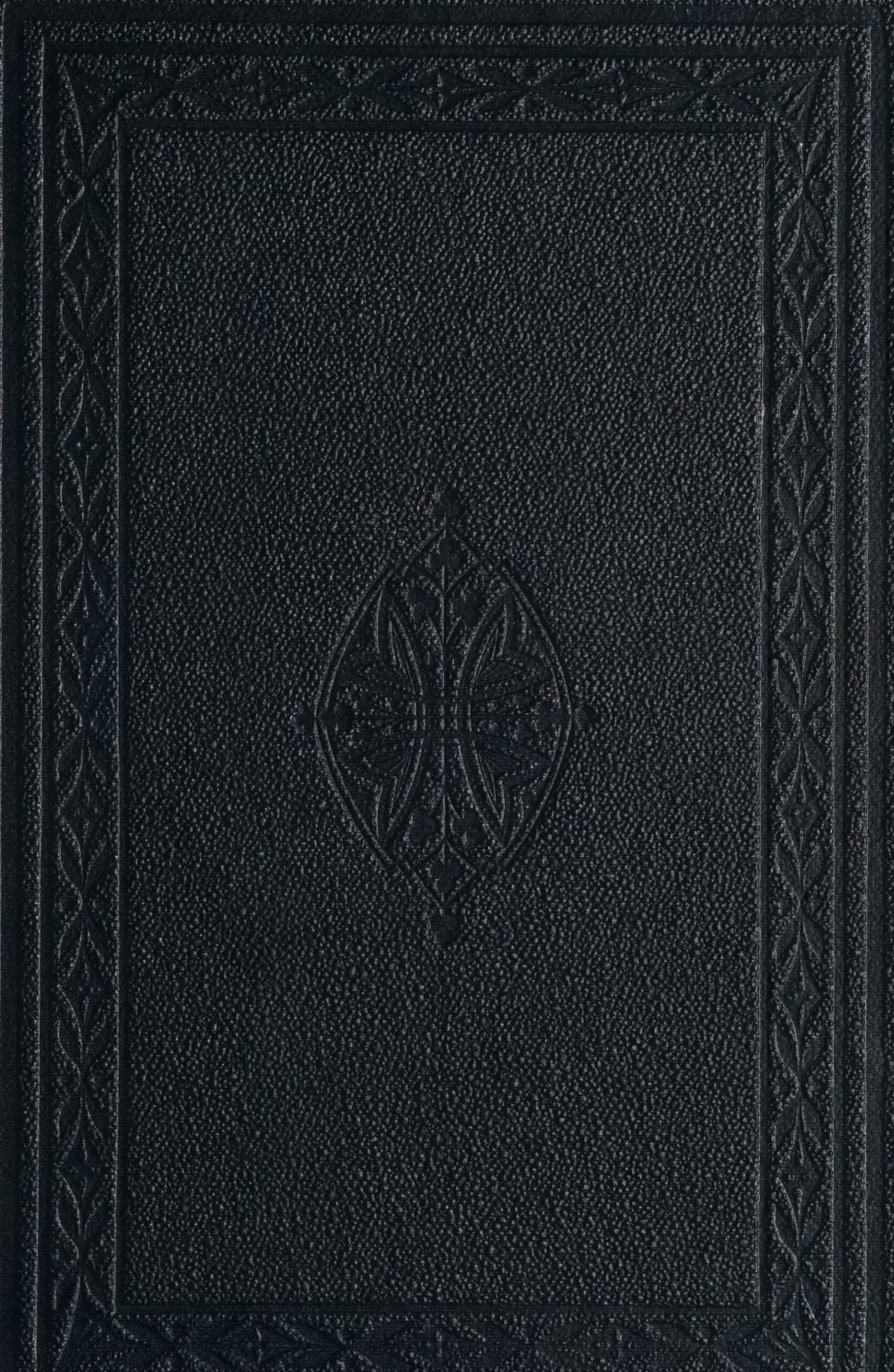

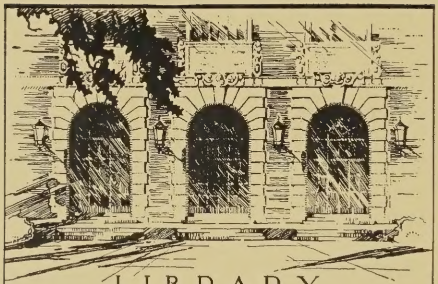

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COLOUR PHOTOGRAPHY.

VOL. II.

1908.

HENRY GREENWOOD & CO., PUBLISHERS, 24, WELLINGTON STREET, STRAND, LONDON, ENGLAND.
SALES AGENTS :—NEW YORK, U.S.A., GEORGE MURPHY, INC., 57, EAST NINTH STREET.
MELBOURNE : BAKER & ROUSE, LTD., HARRINGTONS, LTD., J. W. SMALL & CO., WATSON & SONS, AND GORDON & GOTCH.
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Throughout the Index the following abbreviations are used to indicate the nature of the reference:—

(Pat.) Patent. **(Rev.) Review of Trade Notice.**

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HENRY GREENWOOD & CO., PUBLISHERS,
24, WELLINGTON STREET, STRAND, IN THE COUNTY OF LONDON.—December 25, 1908.
Printed by Love & Malcomson, Ltd., Dane Street, High Holborn, in the same County.

No. 13. Vol. II. January 3, 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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THE AUTOCHROME PLATE IN NATURAL SCIENCE.

For many years I have looked forward to the day when a satisfactory one-exposure method of colour photography should become an accomplished fact, for, in a great deal of my biological work, a truthful colour record would be of very great assistance and value. The various triple-exposure processes of colour photography I found all entailed too much movement, to say nothing when working in the field, of the extra and fragile apparatus in the way of screens, etc., to yield really satisfactory results to the naturalist photographer, whose models are always more or less shy, nervous creatures. Moreover, none of these processes seemed capable of readily faithfully translating the delicate gradations and half-tones of colour in nature. Hard, brilliant colour, yes, any amount of it, and to be obtained with comparative ease, but those subtle transitions of colour that are so all-important in the truthful portrayal of nature, very very rarely.

It was, then, with the keenest interest that I followed the experiments of the Messrs. Lumière, which led up to the production of their Autochrome plate. The results that I have since obtained, both in field and laboratory work, have far exceeded my most sanguine expectations in the truthfulness and accuracy of their colour rendering, and I was particularly pleased to hear the high opinion which I have formed of the delicacy of the colour rendering of the Autochrome plate, most emphatically confirmed by such an authority as Mr. G. A. Storey, A.R.A., in his remarks at the close of my recent lecture at the Blenheim Club.

As the first to apply the Autochrome plates to scientific work, some of my experiences with them may be of interest, and a slight help to others. In the early batches of plates that arrived there appeared to be some appreciable variation in speed, which proved rather disconcerting in determining the correct exposure. But this apparent difference in speed, I am now of opinion, is really produced by delicate variations in the colour of the daylight, frequently very difficult to appreciate optically. If some simple form of meter could be placed on the market, which would register these variations, it would be a great help in the determination of the correct exposure. The whole perfection of the result depends, of course, upon approximately correct exposure, and I have found that it is safer to err on the side of over—rather than under-exposure, the Autochrome plate having considerable latitude as regards over-exposure, but not for under-exposure.

As regards the density of the image, it is certainly advisable never to omit the intensification; and a weak image can be built up, and the plate saved in many cases, by re-intensification. Should the image appear too strong on taking the plate from the final fixing bath, or the subject look dull and heavy, I have found that a very weak solution of Farmer reducer will work wonders in giving pluck and brilliance; but it must be used with great caution, and the plate removed and instantly washed under the tap, to stop the action of the reducer before it has gone too far.

I have had comparatively little trouble from frilling, having generally taken the precaution to dip the edges of the plate in melted paraffin wax before commencing development. It is important, by the way, to remove every trace of the wax before attempting to varnish the plate, or trouble from streaks of partially dissolved wax flowing across the plate will arise. Provided the plate is carefully washed between the first development and solution C, the temperature of the solutions and washing water kept to the same degree, and the plate handled as little as possible, waxing is generally an unnecessary performance. It is very important to most thoroughly clean the glass surface of the plate before placing it in the dark-slide, otherwise markings will appear which are undoubtedly caused by particles of emulsion, etc., that adhere to the glass side of the plate.

As regards exposures in the field, they have varied from four seconds, using a lens working at *f*/4, to 12 or 14 minutes according to the lighting of the subject, time of day, etc., and I have obtained a number of most interesting records in colour of various creatures and plants in their natural environment. In the laboratory I have found the Autochrome plate a most valuable addition for photo-micrographic work, exposures ranging from two minutes to half an hour, according to magnification and subject. I shall hope very shortly to give a few notes on various methods of illumination and manipulation which I have employed with success while using the Autochrome plate for photomicrography.

F. Martin Duncan.

ADVANCES IN THE TAKING, VIEWING, AND PROJECTION OF THE LIPPMANN COLOUR PHOTOGRAPHS.

[Some months ago Dr. Hans Lehmann demonstrated to us in the laboratory of the Physikalisches Institut in Jena the method and apparatus employed by him in working the Lippmann process. The dark-slide, viewing case, and projection attachment which have been worked out by him in conjunction with the Zeiss Optical Factory are illustrated in a recent paper read before the Dresden conference of the German "Naturforscher und Aerzte," for the text of which, giving certain technical particulars, we have to thank Dr. Lehmann.—Eds. "Colour Photography Supplement."]

Dr. Lehmann's work has been devoted to devising a convenient form of dark-slide in which the Lippmann plate may be exposed, to working out a viewing frame in which surface reflections may be avoided, and to designing an instrument for projecting the Lippmann heliochrome by reflected light after the manner of the little-used aphengescope. He has also prepared a gelatine dry plate of a kind ready for use in the Lippmann process, and plates made according to his formula were, we believe, formerly obtainable from the works of Kranseder, of Munich. Since the death of Herr Kranseder, however, some months ago, other arrangements have been made as to the commercial manufacture of the Lippmann plates.

The following is a description of the apparatus as made by the Zeiss works:—

Fig. 1 is a diagram of the dark-slide for holding the sensitive plate and the mercury with which it is backed. The plate lies in the frame A, which is closed by the shutter B, and has the glass side D turned away from the lens. On this surface D a rubber frame J is pressed by means of the screw G, the bar H, and the plate F. The space E between the sensitive plate and F is filled with mercury. This is done by means of the tube L, which is removable from the apparatus. The passages N are so arranged that in either position of the plate, upright or horizontal, there is a head of mercury in the chamber: also that the surface of the mercury remains free as the metal enters the chamber, and lastly that the upper edge of the rubber is not touched. This latter is found to be a necessary precaution towards keeping a clean surface in contact with the image.

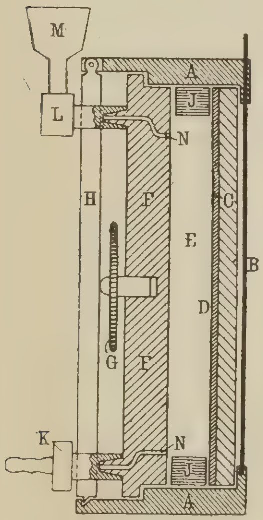

Fig. 1.

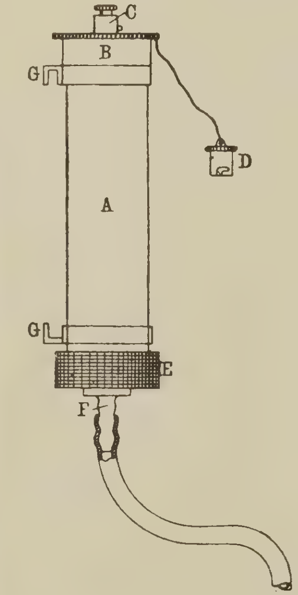

Fig. 2.

For holding the mercury, the vessel shown in Fig. 2 is a convenient accessory. It consists of a cylinder A of polished steel. The screw cover B is provided with an air vent C, which can be closed with the cap B. The inlet and outlet of the mercury are controlled by turning the ring E. The outlet tube F is connected with the inlet K (Fig. 1) by means of a flexible rubber tube. The hook G is for hanging the vessel temporarily to the dark-slide during filling. The joint use of the two pieces of apparatus allow of the mercury being used in the cleanest manner.

The Viewing Chamber.

The Lippmann photograph, as is well known, must be viewed by reflected light, best in an apparatus specially constructed for the purpose. The new Zeiss instrument is so designed that disturbing stray light is cut off and the full colour of the Lippmann heliochrome obtained. Fig. 3 is a diagram of the principle on which the apparatus is made. The heliochrome is provided with a glass wedge to avoid surface reflection, as suggested by Professor V. O. Wiener. In front of this latter is fixed a collecting lens C, at the focus of which the pupils D and F of the whole system are placed. The light is thrown upon the lens C by the total reflecting prism D and the flat mirror E, and transmitted by it in parallel pencils which are reflected perpendicularly by the surface of the image A, and pass for a second time through C to unite at the eye of the observer F. The whole system is placed in a light-tight chamber. It may be arranged for stereoscopic pictures.

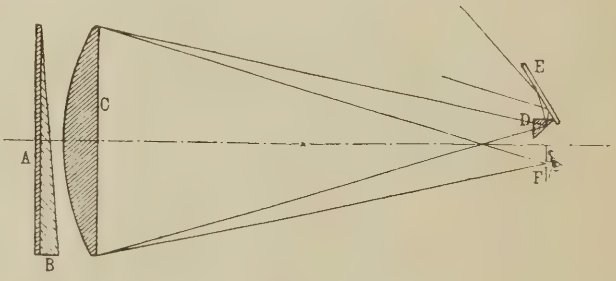

Fig. 3.

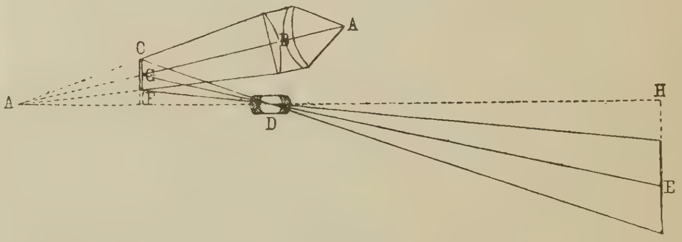

Fig. 4.

The Projection of Lippmann Heliochromes.

A new piece of apparatus has been constructed by the Zeiss works for the projection of Lippmann heliochromes, and can be adapted to the ordinary projection instruments. It permits of the projection of sharp pictures on a larger scale than has previously been possible. Fig. 4 explains the principle of the apparatus. The condenser B throws an image from the crater of the arc lamp A in A^1. This latter, however, is not actually formed here, but in the diaphragm aperture of the projection lens, owing to the interposition of the reflecting image surface C. The optical axis F D H of the projection lens is thus parallel to the surface C F of the image and to that of the screen H E, whilst in the forms of apparatus previously used the optical axis coincided with the line C E, connecting the screen with the centre of the heliochrome.

Visitors to the exhibition of the Society of Colour Photographers were able, during the latter part of the time, to see the viewing instrument, and those who did so will confirm us in describing the effect as more closely resembling a small projection in colours than the lustrous appearance which the Lippmann heliochrome presents without some aid to its proper examination. At Jena we saw the Lippmann heliochromes projected with great brilliancy on a screen perhaps 6 ft. in diameter. The size of the projection is, of course, only limited by the power of the light with which the heliochrome can be illuminated.

To these notes on Dr. Lehmann's work we may appropriately add some particulars of the plate already referred to which appeared in the "Zeitschrift für Wissenschaftliche Photographie" at the time the plates were on the market. On the occasion of our visit to him Dr. Lehmann made an exposure through the correcting filter with a lens working at about *f*/5, and gave for a landscape subject a time of fifteen seconds. The finished heliochrome was ready for viewing within ten minutes.

The plates previously devised ("B.J.," November 30, 1906, page 946) required the use of a somewhat complicated filter to give correct colour rendering. The new plates only require an æsculine filter, 1 : 7,000 solution in 5 mm. thickness, or a gelatine filter of like character.

The maxima of sensitiveness of the new plates lie at λ 635, 585, 509, and 475 $\mu\mu$, and are in complementary pairs, thus 635 to 509, and 585 to 475, which agree with the measurements of A. König and C. Dieterici[1], and these apply for gaslight. In consequence of the maxima at 509 and 475 $\mu\mu$ being somewhat flat, and by suitable choice of proportions, these four maxima do not appear, and the result is that the whole of the picture is too red.

With normal exposure the maxima at 509 and 475 $\mu\mu$ combine to a single one at 492; this also applies to those at 635 and 585, which give one at 610 $\mu\mu$. The two maxima at 610 and 492 $\mu\mu$ are also complementary to one another for sunlight. The result of this process is that correct colour rendering, inclusive of white, is obtained.

The new plates have, however, two important advantages over the old; they are ten times as sensitive to light, and are very insensitive to the mercury, so that fog is not caused. The exposure for a landscape in sunshine is six seconds, with *f*/3.

The colour sensitiveness is so adjusted that fixation of the pictures with a 20 per cent. solution of hypo produces a much better colour rendering. This is attained by increasing the sensitiveness of the plate for deep red.[2] Spectrograms must not, however, be fixed.

The following practical conclusions are arrived at by the author :—

1. Touching the film of the plate before exposure with the finger or brushing with a soft brush is a certain cause of spots. A plate which has been in contact with mercury becomes useless. On the other hand, it is advisable to brush the film after exposure and before development. Rubbing with a leather is useless, and even prejudicial.

2. As Valenta has remarked, the quantity of ammonia in the developer is of great importance. The author finds that increase of ammonia produces greater brilliancy, but lower saturation of the colours.[3] Dr. Lehmann only uses half the quantity of ammonia for spectra that he does for compound colour subjects, and blues and violets are thus rendered with brilliant purity and depth.

Experiments have proved that if the heliochromes have been well washed they can be dried in spirit, hence a considerable reduction of the time involved in making a plate.

4. The liquid generally used for examining a heliochrome in a cell is benzole, as suggested by Wiener, as it has about the same refractive index as gelatine. The author has found that the reflective power of the surface film is always greater than the refractive index for gelatine. The refractive index of the liquid must therefore be increased in order to completely obviate all surface reflections and improve considerably in colour rendering. The best mixture is 12 parts of benzole and 4-5 parts of carbon bisulphide. The unpleasant smell can be lessened by the addition of a few drops of oil of geranium or nitrobenzole.

5. Heliochromes, if unsatisfactory in colour rendering, can be used as ordinary negatives, and they certainly have extraordinary definition and colour rendering.

The great advantage of the new plate is, however, its rapidity. The Lippmann process, as it stands now, is the most interesting, the simplest, the shortest, and cheapest photographic process. From the exposure of the plate to projection on a screen of the finished picture scarcely ten minutes need elapse. A heliochrome 6 x 9 cm. costs about 2½d., and a 9 x 12 only 4d.

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[1] A. König, Gesammelte Abhandlungen zur Physiologischen Optik, 1903. P. 263.

[2] The explanation of this will be obvious from a careful consideration of Professor Cajal's paper ("Colour Photography" Supplement, August, 1907), wherein it is proved the dissolving out the unacted-upon silver bromide must reduce the distance between the laminæ, and thus cause a shift of the colours towards violet.—Eds. "Colour Photography" Supplement.

[3] This is, we think, confirmatory of Professor Cajal's assumption of the formation of a mirror zone. This would certainly increase the brilliancy, but, naturally, lower the saturation or purity of the colours by the admixture of white.—Eds. "Colour Photography Supplement."

A MODIFIED APPARATUS FOR THE PRISMATIC DISPERSION PROCESS.

[The following description, which appears in our contemporary "La Photographie des Couleurs," describes the later form which M. Cheron has given to the apparatus already described in an earlier number of the "Colour Photography" Supplement. The apparatus is still of somewhat unwieldy size, but the defect of even dispersion over a small plate has been removed by the use of a long-focus lens.—Eds. "Colour Photography" Supplement.]

At the close of a former article describing certain improvements in the prismatic dispersion process of colour photography I mentioned that two pieces of apparatus were under construction, and that I hoped to communicate the results within a short time. I must confess that I had not counted on meeting the difficulties which have cropped up in the work and on the numerous experiments which have had to be made. It is satisfactory to say, however, that if the delay has been greater than was anticipated, the results repay one for the time which has been spent. It is true that much still remains to be done in order to reach a complete solution of the problem, but, considering the newness of the process, I believe that it may be expected one day to afford excellent results: it must not be forgotten that we have had to wait more than thirty years for the three-colour method to be offered to us of the degree of perfection found in the grain or filter screen plates.

It will be remembered that the chief difficulty was in the unequal sharpness of the spectra over the whole surface of the image, and, in consequence of the different angle of those rays which do not fall on the prism at the best angle, that of minimum deviation. One of the suggested ways out of this difficulty consisted in increasing the focal length of the second lens sufficiently to reduce the angle at the edges of the plate. This method has been found to give the best results.

I had hoped to have been able to avoid the inconvenience which results from this increased focal length by causing the rays of light to take a zigzag course inside the apparatus by means of mirrors silvered on the surface, and I also hoped to have obtained the pictures stereoscopically. I thus created two new difficulties, and I ought to say that this apparatus has not, so far, given satisfactory results in this respect. I do not despair, however, of being able to adjust matters for the stereoscope, but it was not my wish to wait for these further modifications before obtaining more positive results, and I have had constructed apparatus approximating as closely as possible to the arrangement which I used in my first experiments, but with the second lens of longer focus.

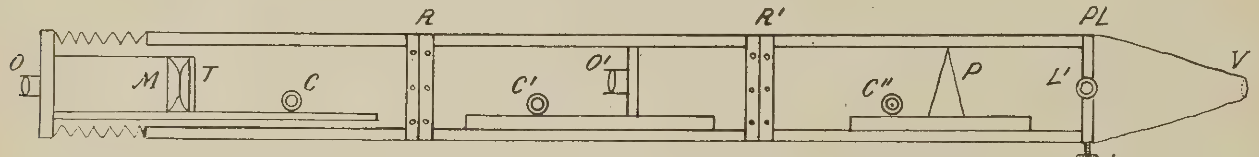

Fig. 1.

O, O′, lenses; M, single lenses; T, screen; C, C′, C″, rack and pinons; R, R′, hinges; P, prism; Pl, plate L, L′, micrometric screws; V, eye-hole.

Instead of causing the rays to return at an angle to their original path by means of mirrors, I allow them to pursue their normal path, with the result that the apparatus is 43 inches in length, although only 4¼ inches high and less than this in width (Fig. 1). Thus it would not be easy to carry it about, and I therefore had it made in three sections, each of about 14 inches in length, and furnished with hinges by means of which the whole folds up into one-third the length, one section in another, as shown in Fig. 2. In this way the apparatus closes to the respectable proportions of 13 inches high, 14 inches long, and 6 inches thick.

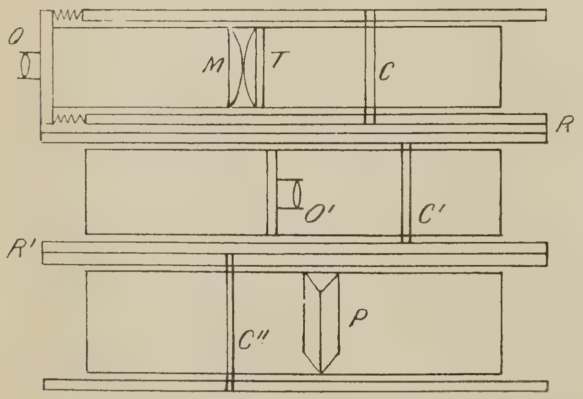

Fig. 2.

When the three sections of the apparatus are in line for the exposure of the plate or the viewing of the result, the rigidity of the whole is assured (to a far greater degree than I expected) by the hinges falling flush with those on which the sections are pivoted, the two separate parts of which are respectively fixed on the edges which unite them. The two halves of each hinge thus fit one on the other, and are held firm by their removable pins, which are pushed in to obtain the result, and are only to be removed afterwards in order to fold up the apparatus.

Connected to the first section by a bellows is the board for the first lens, at the focus of which are placed the first single lens and the screen. The whole is mounted on a board which can be moved backwards or forwards from the outside of the apparatus by a rack and pinion. The middle section contains the second lens (long focus), also mounted on a movable panel.

Lastly, the prism is displaced in the third section, at the back of which is a copper frame provided with grooves in which slide at choice either a carrier for the dark-slides or a small pyramidical box containing the second single lens, the micrometric screws for the adjustment of the positives in position, and an aperture for the examination of the results.

All the rack and pinion movements are actuated by external heads, which are movable and interchangeable: these heads are removed as soon as focus has been secured, and all chance of disadjustment thus avoided.

The apparatus has been fully working only for a short time, but the results already obtained with it have given me confidence in its action. The principal respects in which it is an improvement on those previously used are as follows:—

(1) The spectra are formed over the whole surface of the plate, permitting of the background of a subject being obtained with all its tints up the edges correct in colour. This is the result of the long focus (19 inches) of the second lens on the small plate, 2½ inches square. In my first experiments with a lens of much shorter focus a blue background, for example, would be blue at the centre of the image, but at the edges would tend to violet on one side and green on the other.

(2) There is no variation in the colours on viewing a specimen. Those who saw my first experiments last year at the French Photographic Society will, no doubt, recollect the awful effect produced by the perpetual changes in the colours as the eye was moved to a small extent in the eyehole, small as the latter was. The improvement is due to the greater rigidity and accuracy of the apparatus, the transparency occupying exactly the same position as did the negative during exposure.

(3) The positive colour pictures are quickly and easily focussed by means of the micrometric screws. They can be changed one for another without loss of time, and a half turn of the screw is sufficient to show them with all their colours exact.

(4) Lastly, as the screen is impressed on the plate without enlargement the lines are almost invisible. With good panchromatic plates I have been able by this method to obtain reds as pure and bright as by any other process. I have already made several photographs with the apparatus, which has been used with success. Among the subjects was a vase of flowers with green leaves, white, yellow and red flowers, and a blue background, all of which have been particularly accurately reproduced. The brilliance of the colours may favourably compare with that in the Autochrome or Lippmann process.

The only question, therefore, which stands in the way of the process is the size of the apparatus, and I am, therefore, pursuing my experiments in order to endeavour to bring the length of the camera under 10 inches.

ANDRE CHERON.

THE THEORY OF THE AUTOCHROME PLATE.

[The following abstract-translation of a paper by Baron von Hübl in the "Wiener Mitteilungen" presents the elementary principles of the newer screen-plate processes of colour photography in such clear fashion that it seems deserving of recommendation to the many practising the Autochrome form of the process without an exact conception of the facts on which the process is based.—Eds., "Colour Photography Supplement."]

In the process which is usually called "three-colour" it is well known that the object is photographed through three separate filters, and from the negatives thus obtained three suitably coloured positives are combined to give a coloured reproduction of the original. We have therefore to differentiate between two operations—the photographic analysis and the preparation and combination of the constituent pictures. Both must obviously be in very close connection one with the other, for the analysis must be so effected that it coincides with the colours chosen for the constituent images.

The first question with which we have to deal is the colour of the constituent images, which must be so selected that they reproduce every tint and shade of every colour. At the same time we must bear in mind the possibility of analysing colours by photography into three parts corresponding with the chosen colours.

This last condition limits the colours of the constituent images to one definite colour scheme, so that we need not further discuss the so-called fundamental colours.

The spectrum formed by the splitting up of white light consists practically of three parts—red, green, and blue; whilst the intermediate colours, yellow and blue-green, as well as the end colour, violet, have only a very limited extension. There are thus practically only three constituents in white light, and as the colours of every natural object are entirely due to the changes in white light, so all material colours are merely mixtures of red, yellow, and blue.

From observation of the spectrum it will also be seen that the fundamental colours are vermilion, yellow-green, and ultramarine blue. Mixtures of the three give white; therefore mixtures of two only must give a colour which is complementary to the third. This colour triad must form the basis of every process of colour photography, as the photographic analysis can only be effected by allowing the red, green, and blue constituents of the original to act on three separate plates. If, therefore, plates equally sensitive to all colours are used, the filters must be also vermilion, yellow-green, and ultramarine blue.

From the negatives thus obtained the positives are prepared, the proper colours for which will be obvious from the following considerations:—In the negative taken through the red filter only those rays reflected from the red parts of the original will be represented, and its transparent parts will be representative of those rays absorbed by the red filter—that is to say, the green and blue. This positive, therefore, represents the blue-green portion of the picture, and must be in this colour. Precisely the same argument will prove that the positive from the negative taken through the green filter must be coloured red, and that from the negative taken through the blue filter must be yellow.

The positives may be made in one of two ways: either by staining the positives up with dyes and superimposing, or combining the images projected through a lantern fitted with coloured glasses.

The difference between the projection and the printing positive colours has already been explained very fully by the author,* and it is therefore unnecessary to repeat the information there given.

It is extremely difficult to obtain negatives and positives for these processes of equal character in density, gradation, etc., and variations in the results are inevitable. Retouching or fine etching may be of some assistance in obtaining photo-mechanical pulls of equal quality. If, however, but single examples are required, such a course is impossible, and it is immaterial whether the printing process is carbon, pinatype, or three-colour gum-bichromate, the production of a really successful result is a matter of luck. In spite of many years' research it has been proved impossible to find a satisfactory process; therefore we have had to be content with the triple exposure and triple printing processes.

The Basis of the Three-Colour Filter-Screen.

To solve the problem of indirect photography, the old idea, first enunciated by Ducos du Hauron in 1868, has been again reverted to. A triple-line screen-plate has been used by Joly, Brasseur, and others; but MM. Lumière are the first to produce a practical process.

In the Joly modification of three-colour work only one filter is used for taking the negative, which, replacing the usual three filters, consists of a sheet of glass coated with alternate lines of red, green, and blue colours.

The plate, sensitised for all colours, is covered with this screen-plate, exposed, developed, and fixed. From the negative thus obtained a positive is made and placed in contact with a similarly coloured screen-plate, and with suitable superposition a coloured picture results. Such pictures possess no homogeneous tone, but consist of red, green, and blue lines or points, which are partially covered by the black deposit of the transparency.

A drawing formed of lines or points will, when examined at a suitable distance, as proved by the ordinary half-tone illustration, give the impression of a homogeneous shading, and the smaller the individual elements forming the image the more homogeneous appear the tints. If one assumes that two such linear or mosaic pictures are superimposed, the individual colours can no longer be seen, but the impression is that of the mean of the colours.

The result of the mixing lights is thus independent of irregularities, which are often observed in the mixtures of dyes: the compound colours are usually purer, and appear more as though the pictures were projected by a lantern.

If a surface is coated with lines or dots in two complementary colours, it will appear, with suitable choice of the colours, colourless, and the same phenomenon will be observed with three colours, if each colour is chosen as the complement to the sum of the other two.

Such a surface will be colourless, but it will not appear white, for each colour only reflects one-third of the white light; therefore the whole surface will appear as though coated with one-third white and one-third black. A paper thus coated will appear grey, and a glass plate will have the appearance of a black lined half-tone screen.

If we picture to ourselves a plate coated with the three filter colours, red, green, and blue in lines, as shown in Fig. 1, and with the red rendered opaque, it is obvious that only the green and blue lines, as shown in Fig. 1a, will be visible, and the hitherto colourless surface will appear blue-green: if the blue and green lines are covered, then obviously the surface must be red. It should be noted that this red will be of a deep colour, whilst the blue and green under similar conditions will appear as bright, but less saturated—that is to say, mixed with white, for by the combination of blue and green there is formed with blue-green an equal quantity of white.

In a similar way the covering of each two lines will give a deep blue and a deep green, whilst the covering of only one will give a whitish-yellow and a red-violet.

In a mixture of coloured lights exactly the same thing happens as in three-colour projection. Here also only red, green, and violet can be obtained saturated, whilst the compound colours blue-green, crimson, and yellow show a whitish tint. With the admixture of pigments, however, as in three-colour printing, black is formed instead of white, and therefore the three simple colours—they must be crimson, blue-green, and yellow—appear pure, whilst the compound colours yellowish-green, vermilion, and blue are contaminated with a good deal of black.

If, as in Fig. 1c, the red lines are completely covered, but the blue only partly so, as with a transparent grey film, there is formed a tint intermediate between blue-green and green, and by successive alteration of the deposit in the blue every transition between these two colours may be obtained.

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* "B.J.," June 22, 1906.

If all the lines are covered, the plate will be opaque or black; if they are only partially but equally covered, then it will be grey; if only one or two lines are incompletely covered, whitish tints are obtained.

It is obvious from the above that by complete or partial covering of one or more colour lines all possible colour tones, with their saddened or lightened tints, can be formed, and the result is free from all irregularities and faults which appear in the admixture of pigments. Also the spectrum composition of the dyes used for the lines does not play any considerable part, for rays of similar appearance give similar mixtures.

It is obvious that the covering of the lines is automatically effected by photography. For the lines of the taking filter, vermilion, yellow-green, and blue are chosen, so that each line acts as an individual filter and the same screen-plate serves as a reproduction filter.

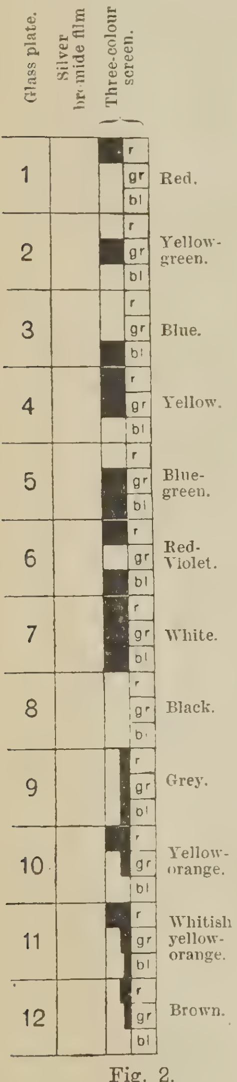

Fig. 2.

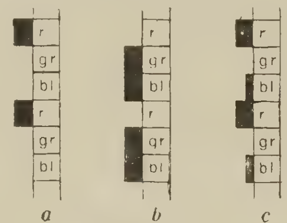

Fig. 1.

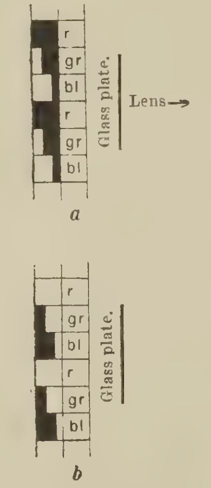

Fig. 3.

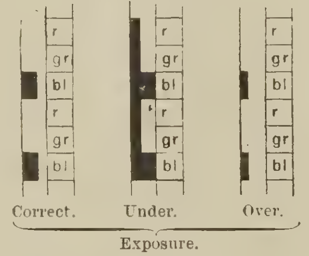

Fig. 4.

In 1 (Fig. 2) the vermilion lines are covered and the spot appears blue-green, 2 appears purple-red, 3 yellow, 4 blue, and so on, 11 shows a blackish and 12 a whitish blue-green, shades which are complementary to yellow-orange, but have a negative character.

If such a linear screen-plate is placed on a plate, equally sensitive to all colours, the rays reflected from a vermilion coloured object will pass through a red line, but not through a green and a blue, so that only under this red line will the silver bromide be affected and blackened by subsequent development. If Fig. 2 represents a section through the two plates and "r," "gr," and "bl," the section through the red, green, and blue colour lines, only the parts behind the red lines will be black after development and fixation, whilst those behind green and blue will be clear glass.

In a similar way with incident yellow-green and blue rays only the silver bromide under the similarly coloured lines will be affected and appear opaque in the negative.

If yellow light, formed of a mixture of red and green rays, falls on the lines of a photographic plate, the blackening will only take place under the red and green lines, for the blue absorbs the complementary yellow rays before they can affect the silver salts. In 5 and 6 will be seen the action of the blue-green and reddish violet rays reflected from the object.

White light penetrates equally all three lines, and causes an equal density, whilst under the black parts of the camera image the sensitive film will remain unchanged. The weakened white light from a grey object will, as shown in 9, only produce partial blackening.

If the colour of the original does not correspond to any line of the screen and is not complementary to any, it will penetrate two coloured fields with different intensity and cause different deposits. Yellowish-orange, for instance, as will be seen from 10, causes a deposit under the red and green lines. A whitish yellow-orange, as shown by 11, acts through all three lines, whilst a saddened yellow-orange, or brown, causes only slight deposit under two lines, as shown in 12.

Thus the light incident on the plate is split up by the closely contiguous linear filters into three parts, and the deposit under the same represents the red, green, and blue parts of the same. If a plate thus exposed is developed, fixed, and placed in contact with a similarly coloured plate, so that the red, green, and blue lines fall in the same places, we shall see a negative or complementary coloured picture.

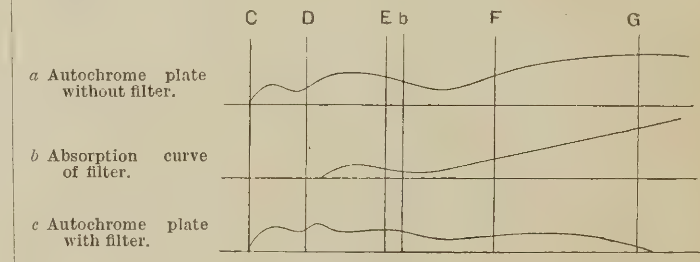

Fig. 5.

If, however, from this negative a transparency is made, and this covered with the linear colour plate, a positive picture in the colours of the original must be formed, which can be easily understood by considering that Fig. 2 is looked through, and that the opaque parts are transparent, and the transparent opaque. The opaque parts in the negative are now transparent, and therefore coloured, and the quantity or the brilliancy of the colours is in ratio to the deposit on the negative.

The theory of this three-colour screen process may therefore be explained as follows:—The rays which fall on the photographic film consist of red, green, and blue light; they penetrate corresponding to the rest of these three constituents, the three analogously coloured lines, and produce a proportional deposit. This deposit will then, by means of the transparency in combination with the line screen, decompose in proportionate ratio the three colours, and there is thus formed a colour picture similar to the original.

As no method of three-colour photography enables one to obtain such correct rendering of the colours of an original as the Autochrome plates, it is interesting, therefore, to see why, and inquire into the reason of this excellent quality.

The plate is coated with a very thin film of gelatine emulsion very rich in silver. The grain is almost as fine as that of a chloride plate. The particles of silver bromide have a diameter of about 0.001 mm., but enlarge during development and intensification to about three times the size, so that a considerable number of silver particles are required to cover a starch grain the diameter of which is 0.012.

When the plate is exposed in the prismatic spectrum, not through the filters, a result shown in Fig. 5 is obtained. From this curve it is obvious that the sensitive film is a gelatine and not a collodion emulsion, and that the blue-sensitiveness is far greater than the red, which only reaches to C.

Generally this would be quite enough, for the red rays beyond C possess such low luminosity that they rarely occur with pigment colours. With certain dark brown reddish tones these rays do act, and therefore such colours would be rendered on the Autochrome plate as almost black.

The spectral green acts more than the red. There is a slight depression and a strong broad one between *b* and F. There is therefore nothing extraordinary about the sensitiveness of the plate, which resembles other commercial plates.

The yellow filter must reduce the blue-sensitiveness so that the curve runs down from the red. It must completely absorb the violet, considerably reduce the blue, and only slightly weaken the green. It is unnecessary to use any special ultra-violet absorbent, as the glass and any yellow dye do this sufficiently.

The absorbtion of the filter is shown in Fig. 5 *b*, and can be imitated with a mixture of filter yellow K and bluish scarlet red.

With the filter the result (Fig. 5 *c*) is obtained, which is certainly not perfectly isochromatic or equal in colour rendering. If a plate is exposed through this filter and the starch grains on the spectrum the colours will be only imperfectly rendered: the yellow will be over-exposed, and appear white, whilst the blue-green, in consequence of under-exposure, will be wanting. With pigments, as they reflect broad spectral zones, the rendering is satisfactory.

As filters the starch grains do not differ from the usual additive filters used for three-colour projection.

Experiments with the Autochrome plate have proved that the speed of the emulsion is about half that of the ordinary Lumière plate. The filter increases the exposure about five times, and the starch grains increase it about four times more, so that the total speed is about 1-40th that of the Lumière panchromatic plate. It is quite possible that faster emulsion and more vigorous sensitising could be used which would reduce the exposure now neccessary to about one-third.

New Books.

"Farbenphotographie mittels einer Aufnahme." By Dr. Mebes. Pp. 84. 9 x 5½. Bunzlau: Office of "Der Photograph." M. 1.50.

Translating the title of this German work on the screen-plate colour processes we are indebted to Dr. Mebes for a most useful monograph on "Colour Photography at One Exposure." The author most industriously brings together current information on the Lumière Autochrome process, to which he adds chapters on the "Omnicolore" plate, the Warner-Powrie process, and the Krayn screen-plate. The greater portion of the volume, however, as is only fitting, treats of the Autochrome process, and embodies a compilation of what has been said and written by most of the Continental workers of the process. The section which deals with the practical use of the Lumière plates is perhaps the most useful part of the volume. It contains a series of tables of failures and remedies connected with the Autochrome plates, our only objection to which is that it gives an exaggerated impression of the difficulties of the manipulation. In historical matters of controversy Dr. Mebes pursues a rather novel course. He holds, for example, that the method embodied in the Powrie patent is totally anticipated by Ducos du Hauron, and appears to think he has perfectly answered any criticism of that view by quoting a letter from Du Hauron in confirmation of his contention. A judge who turns the case over to counsel of plaintiff or defendant would apparently be doing nothing extraordinary in Dr. Mebes' eyes.

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The Autochrome Process.—Our American exchanges are beginning to give signs of the arrival of the Lumière process in the United States. The publishers of "Camera Craft," the Western photographic monthly, edited by Mr. Fayette J. Clute, announce their readiness to supply copies of the text-book, "Colour Photography with the Autochrome Plates," by George E. Brown and C. Welborne Piper, which Messrs. Houghtons Ltd. have issued in this country at the small price of twopence, and which, despite all that has been written on the process, still remains as concise and reliable a guide to the making of Autochrome transparencies as can be procured.

The booklet is obtainable wholesale only from Messrs. Houghtons Ltd., but may be purchased or ordered from any photographic dealer or chemist, price 2d.

Correspondence.

*** *We do not undertake responsibility for the opinions expressed by our correspondents.*

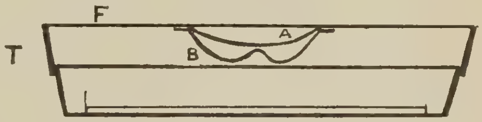
*** *Correspondents should never write on both sides of the paper. No notice is taken of communications unless the names and addresses of the writers are given.*

DAYLIGHT DEVELOPMENT OF AUTOCHROMES BY THE GRAVIER METHOD.

To the Editors.

Gentlemen,—In reference to the three-solution method of developing and completing the Autochrome transparency it may be of interest to you if I describe and illustrate, as far as possible, the method which I myself am accustomed to employ. It allows me to develop and finish an Autochrome transparency within the space of 15 or 18 minutes, and this without a dark-room. I provide myself with a cardboard cover to a developing dish, which cover (T in drawing) is provided on its under side with a small shallow basin, from which to deliver the developer. The dark slide containing the plate is placed, together with the dish, in a changing bag, that which I myself use having the dimensions 70 by 40 cm., and being of the shape shown in the third drawing. The covered dish and dark slide being placed in the changing bag, it is easy to transfer the plate to the former, to place the cover thereon, and to then remove the dish from the changing bag. By then tilting the covered dish the developer is caused to flow over the plate, and is rocked to distribute the solution evenly over the latter. At the end of 2½ minutes I add to the developing solution some 1 per cent. solution of sulphuric acid. This completely arrests development, and after a few seconds I remove the cover of the dish, and, in full daylight, pour away the liquid and replace it by the permanganate reversing solution. At the end of three minutes this is in turn thrown away, and a 2 per cent. solution of bisulphite of soda allowed to act on the plate for a few seconds. The plate is then removed, fanned vigorously in the air with a piece of card or an ordinary fan, and in six minutes will be found to be dry.

Fig. 1.



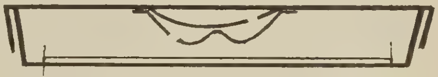


Fig. 2.

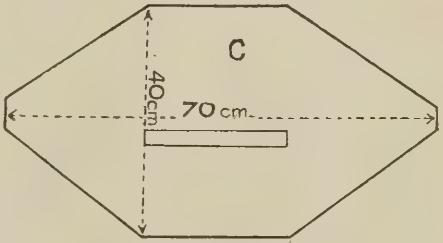


Fig. 3.

Chas. Gravier.

17, Rue des Moines, Paris.

NON-SCREEN PANCHROMATIC PLATES.

To the Editors.

Gentlemen,—In reading over my article on "An Improved Non-Screen Panchromatic Plate by Bathing," as published in the December "Colour Photography," I regret to find that I am made responsible for stating that the best results were obtained with the pinacyanol and pinaverdol aqueous bath, by bathing for three-quarters of a minute, whilst in my paper you will find I have written bathing for 3 to 4 minutes.

Of course, three-quarters of a minute is not even sufficient to fairly wet the gelatine film; also I understand how the error occurred, as the 3 to 4 in figures look very much like a fraction, but my using "minutes" in the plural after the figures should have cleared the doubt.

I am also sorry to see the reproductions of the colour charts have suffered considerably in the press, and practically they prove nothing as to the difference between the plates.

May I add that as regards the difference between a plate bathed in water and one bathed in alcohol, I have found that with the plates experimented with the same result as obtained by the aqueous bath indicated was obtained by using an alcoholic bath, with the difference that the alcoholic bath gave a very streaky negative, whilst these streaks disappeared by using a water bath. As regards tonality between the pinacyanol alcoholic-bathed plate and the pinaverdol and pinacyanol water-bathed plates, there is practically no difference whatever, both negatives being very clear and soft. The pinacyanol and pinaverdol alcoholic bath (using the same proportion of dyes) gives a much more vigorous negative, but has the disadvantage of being streaked and marked, and therefore unworkable.

I have much pleasure in sending you to-day post-office order for my 1908 subscription to the "Journal," without which I am very much afraid I could not exist, and the day of its arrival is anticipated and looked forward to with pleasure every other day in the week.—I am, Gentlemen, yours faithfully,

Messina, December 28. Achille Carrara.

SCREEN-PLATE PROCESSES.

To the Editors.

Gentlemen,—For some years past I have been dabbling in colour photography. Four or five years ago I was working the Ives process and got some very passable results. I gave it up finally because I could not be bothered, every time I wanted to see one of my photographs, with putting it into the instrument. I forget what it was called, but its name was something like Photochromoscope.

Then I left colour photography alone until the Rotary Company's films and other processes made colour prints on paper possible.

I have had a certain measure of success with these—sufficient at all events to stimulate me to further efforts, and to convince me that no process which is incapable of yielding a satisfactory result on paper is of any interest to me

The older three-plate processes, in conjunction with three-colour carbon printing processes, give, to my mind, better results, and moreover results capable of a certain (though limited) amount of control, a consideration of great importance to the artistic worker.

While I still consider the three-plate processes superior to all others, there is no doubt that there are some enormous advantages belonging to the screen-plate processes.

Weight and portability are the most obvious, but I think a more important advantage is the possibility of taking slowly moving objects. For instance a sunset. There is almost always some movement in the clouds, sufficient to make it quite impossible to take it by three successive exposures, whereas on a screen plate the movement being the same for the three colours no colour rims would show on the finished print.

Therefore I am eagerly looking forward to the time when the Warner-Powrie plates are on the market, for I can then go out with no more weight than I should carry for monochrome photography and take photographs of sunsets, or possibly in time, as the plates are made more rapid, snapshots, which will be colour records, and from which (I can afterwards at my leisure make *a set of full tone three-colour negatives* from which I can print on paper).

The words in parentheses represent the usefulness of the process to me, and I have little doubt to many other workers who care for an artistic result more than for scientific accuracy of colouring.

Now, here is my point, which I hope Mr. Powrie and Miss Warner may see and appreciate. Many workers will, like me, probably use their plates solely with a view to subsequently making a set of three negatives. If the ruling of the plates is made too fine will not the difficulty of making the set of three full-tone negatives be enormously increased? I suggest that the plates should be made in two grades:—First, with very fine ruling for printing on Uto paper or otherwise direct; second, with less fine ruling, the number of lines to an inch being settled by what from practical experience is found to be the most convenient number from which to make full tone negatives.—Yours faithfully, L. Walker Munro.

Rhinefield, Brockenhurst, Hampshire, December 18, 1907.

[Our correspondent's suggestion of a plate of fine ruling from which to make copies on bleach-out paper would not help matters so far as we can see. It would still be necessary to triplicate the action of each colour band, a process which can be carried out with 600-line ruling, adopted in the Warner-Powrie process. This same ruling is found satisfactory for the making of three full tone negatives.—Eds. "Colour Photography" Supplement.]

News and Notes.

An Exhibition at the Polytechnic.—During the present week an exhibition of colour photographs and transparencies—the latter, with one exception, Autochromes—may be seen at the Polytechnic, Regent Street, London, W. The collection has been brought together by Mr. Howard Farmer, the principal of the Polytechnic Photographic School, and by his efforts nearly one hundred transparencies and something more than a score of paper prints have been placed on exhibition, and may be seen any day of the present week, from 10 a.m. to 10 p.m. Silver and bronze medals were offered for competition, and were awarded by Mr. George E. Brown, Editor of the "British Journal of Photography," as follows:—

Class A.—Portraiture by the Autochrome process: Silver medal, Walter L. Bourke, Maidenhead; bronze medal, R. Hunt, Wealdstone.

Class B.—Other subjects by the Autochrome process: Silver medal, William E. Gray, Bayswater; bronze medal, F. Kilburn, Roundhay, Leeds.

Class C.—Colour prints by any purely photographic process: Silver medal, Henry J. Comley; bronze medal, Samuel Manners, London. Both these two last-named exhibitors' work was by the three-colour carbon process, some further specimens of which were shown, but not for competition, by Mr. Comley and by the Rotary Photographic Company, Ltd. Mr. Manners, who takes the second award, is evidently a practised worker, of whom, it is to be hoped, more will be heard in colour exhibitions.

No charge is made for admittance to the exhibition, which, as we have said, remains open for twelve hours daily until tomorrow, Saturday, January 4.

M. Lumière père in America.—M. Antoine Lumière, the founder of the Lumière firm, was entertained at dinner in Philadelphia on December 17 by the editors of the "Camera" and the "Bulletin of Photography." The guests invited to meet M. Lumière included C. Yarnall Abbott, John Bartlett, Chas. W. Beck, jun., A. T. Bradley, J. E. Brulatour, Wm. M. Bunn, Frank V. Chambers, C. H. Claudy, Kendall B. Cressy, Maurice Damour, E. Clarke Fowler, John T. Gibbs, Elias Goldensky, Prof. Arthur W. Goodspeed, L. J. R. Holst, Louis E. Levy, Max Levy, Frank D. Long, Antoine Lumière, Edouard Lumière, Dr. James MacAlister, Pirie MacDonald, Ryland Phillips, Wm. H. Rau, Henry Starr Richardson, E. A. Scott, Alfred D. Silliman, Alfred Stieglitz, Howard A. Stone, and T. Dixon Tennant. The discussion of the subject created the greatest enthusiasm among the photographers present, and the banqueters vied with each other in toasting the inventor. M. Lumière cannot speak a word of English, but he responded gracefully to the tributes paid to him, and the words were translated by J. E. Brulatour, of New York.

"If I were not a Frenchman, I would certainly be an American; and if I were an American I would not want to be a Frenchman," was his neat response to a toast to his native land. He emphasised his friendly feeling for his hosts by embracing Pirie MacDonald, of New York, one of the speakers, and implanting a kiss, in Continental fashion, on his cheek.

Mr. MacDonald described the struggles which had filled the life of Lumière. At the age of 14 he became a sign painter, and first took up the study of art. He became a photographer, and one of the first things that interested him was the possibility of reproducing natural colours by one exposure. He and his sons invented the cinematograph, and also compounded several valuable pharmaceutical preparations.

No. 14. Vol. II. FEBRUARY 7, 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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AN AMIDOL FORMULA FOR DEVELOPMENT OF AUTOCHROMES BY INSPECTION.

(A Paper in "La Photographie des Couleurs.")

The method of treatment of Autochromes advised by MM. Lumière necessitates perfect darkness during development, and the majority of amateurs are so convinced of the necessity of this that it is generally accepted as an article of faith.

Whilst automatic and rapid development, which gives the best results with ordinary plates and films, is due to the thickness of the film, with plates with such thin films as the Autochromes it is less advantageous. In this case even slight errors become disastrous, and results, according to the makers themselves, are not satisfactory if the under- or over-exposure exceeds half or double the correct exposure. MM. Lumière, it is true, have given excellent formulæ for correcting considerable under- or over-exposure; but there is one great drawback: to correct errors in exposure the first essential is that one should know on which side the error in exposure lies.

We think that now we can give a satisfactory solution of this double problem, viz., examination during development and a sufficiently near approximation to the time of exposure.

To arrive at a more certain result which shall present all the required guarantees, we thought it advisable to study first the colour-sensitiveness of the plates; and secondly, the action of divers reagents first on local and then on general sensitiveness.

To deal with the first part of our programme, we have exposed plates in the spectrograph so that the light fell directly on the sensitive film without traversing the starch grains. The results were certainly rather surprising, and appear to be in disagreement with the theory of three-colour photography. We have found that the panchromatism is by no means perfect, as one might believe, for it does not extend without break from the violet to the extreme red. It extends to nearly C, about λ 650—that is to say, rather less than with pinacyanol, λ 670, and presents a rather marked minimum between E and F in the dark green λ 515. This minimum, by its intensity and position, recalls a plate sensitised with pinacyanol.

Spectrographic examination would appear at first sight to permit of manipulating the plates in extreme red light, beyond λ 650, or, better still, in green light of λ 500 to λ 530.

It is to this that we give the preference, because it is less fatiguing to the eye, and enables one to follow more easily the appearance of the image. We have used a Pigeon lamp and green glasses coloured in the mass. As these have not the theoretically correct absorption, but transmit too wide a spectral zone, we have filled the dark slides and developed for the first two minutes at a distance of 1.50 metres (5ft.) from the lamp. But it is better to be able to have some light during development, and the following is the method by which we have determined, if it were possible, to work without danger of fog.

We prepared different formulæ of the usual developers. Strips of unexposed Autochrome plates were immersed in the same for one or two minutes, and then exposed in the spectrograph, so that on development equal densities were obtained in the blue-violet. Other strips were immersed in the same way in solution of sodium bisulphite of various strengths, and then after washing exposed and developed.

Examination of the spectra thus obtained has shown us: (1) a plate, immersed for two minutes in most of the alkaline developers, requires, to give the same density in the blue-violet, an exposure about five times longer than without this preliminary bathing, and its colour sensitiveness is slightly decreased. (2) A plate immersed in amidol without bisulphite appears to have its general sensitiveness markedly decreased about eight times, and its colour-sensitiveness decreased still more. (3) Amidol in acid solution possesses the same property, but to a greater degree. The plate, after immersion for about two minutes, appears about thirty times less sensitive to blue-violet, and to have lost its colour-sensitiveness almost entirely. (4) Finally, to obtain the same result with bisulphite alone before development so as to make the illumination less dangerous. a stronger bisulphite bath must be used—that is, the commercial solution is diluted to 10 per cent. and a longer immersion given. This may remain two minutes or more, and the plate must be washed for thirty seconds. The colour-sensitiveness, although reduced, persists more than with amidol in acid solution.

From these trials, and from practical experiments confirming them, we have drawn the following conclusions:—It is possible to develop Autochromes, preferably with the formulæ given by the makers, but also with other energetic alkaline developers with a little bromide, in green light, if the plate be examined only after immersion therein, and then not often. We have not tried to give exact formulæ for the different alkaline developers, those given by the makers being excellent from this point of view. There is no doubt, however that interesting results would be arrived at, particularly with eikonogen and glycin.

The development is preceded by immersion in bisulphite solution; the illumination of the dark-room may be less parsimonious as the colour-sensitiveness is reduced.

Amidol in acid solution, according to our way of thinking is the most advantageous developer; in fact, not only does it completely annul colour-sensitiveness so that one can work in yellow. red, or green light, but it also decreases enormously general sensitiveness till it becomes as easy to follow the appearance of the image on an Autochrome plate as on bromide paper.

Added to these advantages we have that of being able to correct considerable errors in exposure. We have made a series of pictures with exposures 2½, 5, 15, and 60 minutes, 15 minutes being correct. Not one was intensified; all are good, and might be taken to be identical, except that, pushing the tests to the extreme, we developed the first a little too long, which gives it the softness of an over-exposed plate. and the last was developed rather too little, so that it is too dense, like an under-exposed plate. We think these results are worth noting.

After many trials we arrived at the following formula, which gives results absolutely identical with the pyro-ammonia developer of the makers, with correct exposure:—

Sodium bisulphite (commercial solution)	4	parts.
Sodium sulphite (anhydrous)	3	,,
Potassium bromide, 10 per cent. sol. ...	2	,,
Amidol	1	,,
Water	100	,,

Development takes twenty minutes at 60 deg. Fahr. for correct exposure, and from two minutes to one hour for exposures varying between a quarter and fifteen.

Autochrome plates will actually stand an hour's development, but it is more preferable, if the image is slow in coming up, to immerse the plate in a strong developer, in which it will rapidly appear.

In fact, if the varnish which separates the emulsion from the starch grains has any accidental holes, development prolonged to excess may involve the appearance of a characteristic reddish tone. Thus, in this case, we have recourse to an amidol developer with less bromide and without bisulphite, as follows:—

Sodium sulphite (anhydrous)	3	parts.
Potassium bromide, 10 per cent. sol. ...	1	,,
Amidol	1	,,
Water	100	,,

Development is always easy to follow. It is only necessary to push development to the end, for the image always appears more intense than it actually is, or, rather, the silver bromide not reduced and destined to give the positive after reversal, always remains in greater quantities than one would believe. from its transparence, which makes it inappreciable where it exists in small quantities.

It is these small quantities of silver bromide which give to the finished picture the most delicate half-tones, and it is very important to preserve them with all their value. After a little experience a green light is much more serviceable than a red one, for it permits one to follow the progress of development much better. The question of correctness of exposure of Autochrome plates ought to become a secondary consideration with this new method of working.

CHARLES SIMMEN.

AUTOCHROME NOTES AND ACCESSORIES.

Commercial Value of Autochromes.

ONE of the almost obvious uses in the business world for the Autochrome picture is to use it as a means of describing some picture, porcelain, or other article of vertu to some possible purchaser who is unable to view the article itself. Dealers frequently obtain possession of an object of considerable value, particulars of which they wish to submit to well-known collectors in various parts of the world, and the Autochrome transparency gives not only the form and condition of the specimen, but also its colouring and the quality of its glaze if the object be a piece of porcelain. The cost of an Autochrome transparency—say. one to two guineas—is a small matter where the sale of an object worth some hundreds or thousands of guineas is in question, and the method of description should commend itself to both dealer and purchaser. We suggest to those of our readers who are in touch with dealers that the idea is one worth pushing. The progressive workers who get such work during early days are those who obtain the best prices, and, while making a fair profit, maintain their reputation for skill in manipulation and up-to-dateness in method.

Exposure with Autochromes.

A correspondent of "Focus," describing his experiences in the matter of exposure, states that in the summer he found the Wynne Number to be *f*/14 in the sun and *f*/8 in the shade. In December he obtained good results by taking the speed as *f*/4 in the sun, while in the shade he took the same speed number and multiplied the exposure by 4 or 5, which is equivalent to taking the speed at *f*/2. From this it seems that the difference between the speeds in sunlight and shadow is the same in either summer or winter, while the difference between the exposures required in summer and winter in similar circumstances is about 1 to 12. We have not attempted to confirm these results, but, judging from our past experiences, they are probably very nearly correct. It will be interesting to see if similar conditions hold good with other screen-plate processes when such become generally available. There is no apparent reason why the Autochrome plate should be peculiar in the matter of exposure, and, in view of the fact that many other similar colour processes are on the way, it is evidently desirable that this matter of speed and exposure should receive careful attention. Possibly the problem would best be solved by the invention of a quite new kind of exposure meter. It is, however, difficult to suggest the manner in which the method of light-testing should be modified, seeing that it is by no means clear whether the trouble is due to the fact that we are dealing with colour, or to the fact that in colour work we are using light that is cut down to a very low intensity by the various filter screens. Perhaps, after all, the simplest solution will be the compilation of a table of variable speeds for different times of the year and different times of the day. It must not be forgotten that the variations in a single day are just as obvious as those that exist between summer and winter.

Remedying Colour Effects in Autochrome Plates.

M. G. A. Le Roy, commenting before the French Photographic Society on the tendency of Autochrome transparencies to be too bluish when under-exposed, and too reddish when over-exposed, goes on to prescribe a remedy for these defects in the shape of weak staining baths capable of imparting to the plate a slight colouration, the complementary of that which it possesses. Thus a bluish plate is immersed for a few minutes in a weak bath of yellow, such as Poirer's Orange II. Such a bath must be of the requisite dilution, and must not be allowed to act too long, or the result will be disastrous.

A Varnish for Autochromes.

M. G. A. Le Roy, in a recent short communication to the French Photographic Society, has recommended a formula for a varnish preferable to that of gum dammar in benzole on account of its lesser degree of inflammability. He employs carbon tetrachloride as the solvent and dissolves it in a mixture of dammar and mastic as follows:—

Resin dammar	10 gms.
Mastic (tears)	10 gms.
Carbon tetrachloride	150 gms.

The three ingredients are best warmed moderately together in one bottle, and the solution filtered through paper into another.

Acid Amidol as a Developer of Autochromes.

MM. Balagny and Simmen state in a recent issue of the "Bulletin" of the French Photographic Society that the acid amidol suggested by the former is excellent for Autochrome plates, and that after the first minute the plates may be manipulated in a deep-red light, as the acid developer destroys the red sensitiveness of the plates. After a few minutes plates may even be developed in deep orange light. The developer recommended is:—

A.	Sodium sulphite cryst.	18 gms.
	Distilled water	85 ccs.
	Sulphuric acid, 10 per cent. sol.	18 ccs.
B.	Sodium sulphite cryst.	6 gms.
	Potass. bromide, 10 per cent. sol.	4.5 ccs.
	Amidol	1 gm.

To the above quantity of B add 9 ccs. of A, and after a minute the progress of development may be watched in a deep red light.

THE PURKINJE PHENOMENON IN PHOTOGRAPHIC PLATES.

The Purkinje phenomenon, which has involuntarily obtained some spurious notoriety of late in photographic circles, is a purely physiological phenomenon, which arises from the difference of sensitiveness of the rods and cones in the retina to colours. The former are most sensitive to green, and the latter to yellow or red. Given lights of equal and great intensity, there is no difference, because the cones only act, but as soon as the luminosity is reduced, then the phenomenon at once comes into play, for then the action of the rods begins—with the result that in a dim light green is more luminous than red. Inversely, with increase of illumination, red increases in luminosity more rapidly than green. That better illumination is given by a dim green light was pointed out many years ago, in connection with dark-room lights, by Sir William Abney. This phenomenon must not be confounded with what we may call the blindness of the "yellow spot" of the eye to green, which is an entirely different phenomenon to the absorption of green by the colouring matter of the yellow spot. This comes into play only when areas of colour or lights of small area are examined at varying distances; that is to say, when the images of coloured objects or lights are formed on the retina of different angular measurements.

BEFORE a recent Congress of the German Physical Society Dr. Hans Lehmann gave a summary of the present condition of colour photography, towards the conclusion of which he elaborated a theory as to the existence of the Purkinje phenomenon in colour-sensitive plates.

Dr. Lehmann points out that modern painters, during the last fifty or sixty years, have represented the shadows in their pictures of different colours from the high-lights, and this independently of any differences of luminosity and the consequent change of purity or saturation or coloured reflections, etc. The old masters always painted their shadows grey or brown. The author has not found any good explanation of this fact in the literature of the subject, but says that doubtless it is due to Purkinje's phenomenon. The human eye has learnt by experience to differentiate shades of extreme delicacy as required by the phenomenon in question. Painters exaggerate these delicate differences more or less, as according to the modern views the representation of these "coloured shadows" is of the highest importance from an artistic point of view.

It is an interesting fact that the human retina not only shows Purkinje's phenomenon, but that dry plates do so also. Herr J. Precht[1] was the first to point this out, and formulated the following law:—"The relative chemical luminosity of two light sources is dependent on the absolute value of the time of exposure or on their absolute intensity."

The author goes a step further, and advances the statement that the relative chemical luminosity of any light source is dependent as regards its spectral composition on its absolute intensity. As proof of this statement, the table of measurements on opposite column, of the opacities of some spectra, taken on a colour-sensitive plate, of a reddish light with different times of exposure or luminosity is given.

The first column gives the times of exposure or intensities, the two next the opacities for the maxima of sensitiveness, and the last the ratio for the time being of the opacities. (The intervals of intensities could have been made still greater so as to have permitted of proof of still greater differences in the ratio of opacities.) The last column shows, however, that, applied to colour photography, the ratio of colour composition is a function of the absolute intensity; and actually in the example given the colour shifts towards blue with decrease of intensity—that is to say, the image of a reddish object would appear bluish in the shadows. If the plate possesses three maxima, the ratios are quite analogous.

The general deduction to be drawn from the above is that the greater maximum increases more rapidly with increasing intensity. The result will be that the image of a reddish violet object will always show reddish shadows.

PURKINJE PHENOMENON.

Seconds.	Opacities for Maxima at		$\frac{0450}{0650}$
	λ 450 μμ	λ 650 μμ	
15	7·2	9·6	0·76
40	21·9	32·4	0·68
120	70·8	123·0	0·58
300	199·5	371·5	0·54

The above-named law does not explain why it is that sometimes the shadow parts of white objects, especially on Autochrome pictures, appear intensely blue, and this without any subsidiary reflective action.[2] Here, according to the above law, all three maxima must act equally, and their ratios cannot essentially vary.

The explanation of this rather lies in the well-known fact that with very low intensities blue always develops before the colours at the less refrangible end of the spectrum, which is the result of the different absorption of the film for rays of different wave-length.[3]

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[1] Arch. f. Wiss. Phot. 1. 277.

[2] Also pure black or very dark colours are always reproduced more blueish, even although the object may have a reddish tinge—for instance, dark clothes, etc.

This is a kind of Purkinje phenomenon other than that described above. One might differentiate between these two by calling them Purkinje phenomena of the first and second order.

One can with some truth express the opinion that the Purkinje effect, which is a purely physiological phenomenon, is nothing more than a behaviour of the retina identical with the photographic film.

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[3] This is entirely an optical and not a photo-chemical process. The red rays penetrate deeper into the film than the blue; they require, therefore, a longer development than the latter, the action of which lies principally on the surface.

THE PRODUCTION OF COLOUR-SCREEN PLATES.

[An abstract of the chief points dealt with by Dr. Mees in his lecture on January 15 at the Society of Arts on "Screen-plate Colour Photography," appeared in "The British Journal" for January 17, but we now reprint here those portions of the paper which touch upon matters of manufacture which have not been treated in the same way or with the same authority already in our pages.—Eds., "Colour Photography" Supplement.]

Forty years ago Ducos du Hauron suggested the production of a screen plate, as forming a simple method of colour photography, which was to consist of a sheet of transparent paper mechanically covered upon its surface with three kinds of coloured stripes or divisions. "Let us imagine," he writes, "that one covers the surface of the paper on the side where the colour stripes are imprinted with a preparation which gives directly, under the influence of light, a positive proof, and that one receives on its reversed side—namely, on the side not covered with stripes—the image of the camera. It will happen that the three single colours will filter through the paper and form each its positive print, i.e., its print in light of the corresponding ray of colour, and the three prints will be formed with the same rapidity, in spite of the unequal degrees of actinism of the three simple colours, if one has been careful to give to each of these three sorts of stripes a relative translucency, inversely as the photogenic power of these same colours on the preparation employed."

This was in 1868, and it forms the basis of the screen-plate processes, the first of which was put forward commercially in 1895, when Professor Joly invented his system of screen-plate photography. Professor Joly ruled on gelatine-coated glass his sets of three lines, and placed the screens so prepared in contact with the sensitive plate. After exposure, the plate was developed, and a positive made, which was then again placed in contact with the screen, the result being a most satisfactory image in colours. The real difficulty of the Joly process appears to have been the difficulty of obtaining plates which should be regularly of the same sensitiveness. The compensating screen which fitted one batch of plates would not fit another, and this difficulty was sufficient to be a grave objection to the general application of the process.

Somewhat previously to Professor Joly's method, Macdonough had prepared plates by scattering over their surface small flecks of coloured shellac, and then fusing these flecks on to the surface. But Macdonough became convinced of the superiority of the line method, possibly mainly because of registration difficulties, and he founded the International Colour Photo Co., with a view to the production of screens by machinery in large quantities. The plates were ruled with fine lines by means of celluloid wheels, from which coloured inks were deposited upon the surface of the plates; the process was very difficult, and the plates were extremely costly to make. Mr. G. E. Brown states that one weak spot in the process was the difficulty of getting proper contact between the sensitive plate and the taking-screen in making the exposure, but that the company failed on account of the cost of the plates.

In the Sampolo Brasseur process, one of these line-screen negatives, made as in the Joly process, is separated into its elements by means of superposition on the line negative of a black-and-white screen in which the black lines are twice the width of the clear space; the whole plate being moved sideways on the plate used for making the positive, so that each line element is spread out to three times its width, the lines being printed in turn. From the three positives thus prepared prints are made by any of the usual subtractive processes.

In the Joly, Sampolo Brasseur, and the International Co.'s processes, the photographic film was separated from the screen. This has greaet advantages in the production of positives, but it involves difficulty in registration, and also, owing to the usually unsatisfactory nature of the glass which is used, considerable difficulty in obtaining sufficiently close contact. The difficulty of registration necessitates the use of regular screens, as it will clearly not be possible to register irregular screens, and consequently later experimenters have prepared plates with a view to the coating of the sensitive emulsion upon the surface of the screen-plate itself.

Mr. Powrie, who has worked out his process in collaboration with Miss Warner, devised this process originally to overcome the difficulty of preparing line-screens by machinery. Mr. Powrie produces his line-screens by the following method:—

A plate is coated with a mixture of bichromated fish glue and albumen, and is exposed to arc light beneath a black line screen in which the black lines are twice the width of the spaces. After exposure, the plate is washed, the water washing away the unexposed fish glue and leaving only the deposit beneath the exposed lines. The plate is then dyed green, and the dye is mordanted home. The plate is then again coated with bichromated fish glue and re-exposed beneath the screen, but the exposure is arranged so that the green lines are completely covered by the black lines of the line screen. This has been arranged in practice by placing the plate on the screen and twisting it in its frame by means of set screws until the moiré pattern vanishes; the plate is then moved at right angles to the direction of the lines, until the whole screen appears bright green, thus showing that the screen lines exactly fill the clear space of the black and white screen. The plate is moved by the width of one line and a half, so that it is completely behind the black line; it is now exposed again and the second line is dyed red. After re-coating, the plate is again exposed through the back without the black and white screen, the red and green lines serving as shields to the fish glue. After washing, this last coating is dyed blue, and the blue lines just fill the spaces between the red and green lines.

It will be clear that by this process we get a screen of which the whole coating is in one plane, and if the process is as cheap to work as might be expected, there is probably a considerable future for it. The lines can be made very fine, the production of finer black and white screens being accomplished in a similar manner. Thus, if a coarse line screen is taken, a bichromated fish glue plate is printed from it, and the lines turned black by a ferrotannic process; this plate is then replaced so that the black line is exactly in the middle of the black screen line after recoating: this gives us another screen plate of the same pattern as our first, but with twice the number of lines, and the process can be repeated almost indefinitely.

Another line-process has been patented by the veteran Du Hauron. In this, which is termed the Omnicolore Plate, two lines are printed in greasy inks crossing at right angles, the actual crossing point being, according to M. Hauron, avoided. The spaces are then filled up by means of a water-colour which is repelled by the greasy ink.

One of the most unpromising of screen-plate processes at first glance is that which has first come on the market, the starch grain process of the Lumière Bros. One may almost imagine that, had the difficulties which must have occurred in the production of the starch grain plate been met by less resources and skill than those of the great Lyons factory, so difficult a process as the starch grain could scarcely have been utilised commercially; but those difficulties have been overcome, and the one process which is on the market is the Autochrome process. In this, the screen is manufactured by the following method:—

Grains of starch are taken and sorted until only those between certain limits of size are isolated. These are then divided into three portions and stained to give the requisite filter colours. They are then again mixed as completely as possible, and scattered on the surface of the plates, which are rolled to flatten the grains. After rolling, black is dusted on the plates to fill up any spaces which may occur, and the screen is covered with a medium to prepare it for receiving the film. The starch grains average between 1-1000 and 1-2000 of an inch in diameter, and when one considers the difficulties of the process, the mechanical perfection attained is astonishing.

A process which is stated to be nearly ready is that invented by Robert Krayn. In this process the screen consists of a sheet of celluloid made in the following manner:—

Sheets of celluloid are stained in the requisite colours, and are then placed on the top of each other and cemented together so as to form a continuous block composed of sheets of red, green, and blue celluloid; a section is then cut straight through this block and a leaf is obtained which shows throughout its width the red, green, and blue lines which were originally the leaves forming the block. The system, in fact, is exactly that used in forming "Edinburgh rock." To make the Krayn mosaic screen these line-screens are again cemented together and form a block, and a section is now cut at right angles to the line direction. The colours of the Krayn plates which I have seen have been very good, but it is difficult to get the lines sufficiently fine. This involves the cutting of extremely thin celluloid sections; it must be remembered that the narrower the lines become, the finer must the celluloid be, otherwise the parallax error due to the thickness of the line will be appreciable, and it will probably be necessary to support the film on glass if it become so thin. Also, if the line is to be made very thin, it is necessary to dye the celluloid very deeply in order that the colours may be of the requisite intensity.

Dr. J. H. Smith has patented the production of screen plates by printing the units photo-mechanically in geometrical patterns.

Another method of making a screen plate is that which has been patented by Rudolph Berthon and Joseph Gambs. They suggest that transparent filaments should be used to make fabric by the ordinary weaving method, this being varnished on the plate and then coated with the emulsion.

C. L. Finlay has patented the printing on a plate of two separate sets of circles, the space left between them being filled in with the third colour.

H. W. H. Palmer has patented two methods of preparing screen plates. One is similar to that used by Macdonough. He covers the plate with small particles of coloured glass, mixed to produce a neutral grey, and then fused on by firing in a kiln. Another method he suggests is spinning glass filaments on to the plate, and then firing in the same manner.

The production of screen plates is, as these examples will show, possible of accomplishment in very many ways. The conditions of success, apart from the necessity of obtaining a satisfactory plate, also involve the question of cost of manufacture.

A method which I have employed for preparing screen plates, showing wide lines, for the illustration of this paper, is to coat a sheet of glass with bichromated gelatine on the ordinary coating machine, and expose this glass under a line-screen having the black line one-half of the width of the space. In this way two-thirds of the width of the screen becomes hardened, the lines covered by the black screen line remaining soft; this soft line is then dyed up with one of the many dyes which do not penetrate hard gelatine, and after drying, the plate is again coated with bichromated gelatine, the second and the third line being put on in the same way. This method of manufacture is quite simple with coarse lines such as were necessary for illustrative purposes, about fifteen to the inch, but I should doubt if it would be commercially practicable for small units.

It does not follow that the method which comes to the fore is easiest of production, or the one calculated to give the best results; either of those things may be true or they may not. In order that a process may be commercially introduced, there is required not only the primary idea, but a great deal of patient working out, and probably a manufacturing house behind it, because in the end the production of anything of this sort is a question of commercial scale working, and only a factory can experiment on a sufficient scale.

Conditions for the Production of the Filters.

It was explained at the beginning of this paper that the screen-plate processes are additive processes of colour photography, and the importance of this fact becomes manifest when we consider the filters. The taking-filters for an additive process are the same as for those of a subtractive process. The conditions then for the taking-filters are:—That the red should be a sharp-cut filter transmitting the scarlet and orange to, say, 5,800 A.U., but not transmitting the green or blue. The green filter should overlap the red, and also to a somewhat greater extent the blue, though overlap on the blue side is not so important in an additive process as in a subtractive; so that if our filter extends from 6,000 to 4,800, we may regard it as satisfactory. The blue filter should not transmit red, and if the dye used in it absorbs the ultra-violet to some extent, there will be less difficulty in making the compensating filter. The blue filter should transmit from 5,000 to 4,000.

These, then, are the conditions for ideal taking-filters, but if the screen-plate is to be turned into a positive, there will not merely be the taking-filters, but also the projecting filters, and for projecting filters the conditions are different. In order that strong colours should be obtained when using projecting filters, it is necessary that the spectrum cuts should be fairly narrow, and, if possible, they should not overlap.

Overlapping projecting filters will give distinctly washy colours, diluting pure colours with white, so that in manufacturing a screen that fact must be remembered; and in practice if we are to reverse our screen-plate and turn it into a positive, the filters must be a compromise between the taking and projecting filters. Probably the best compromise is that the filter zones shall touch but not appreciably overlap; this is realised in the Autochrome plate.

Testing the Filters.

The exact area of the filter zones may be easily found from the screen-plates themselves. It is possible to take micro-spectro photographs showing the absorption spectra of the filters. Thus by using an enclosed arc (barium being introduced into the arc to produce a line spectrum) focussed on the condenser of a microscope, with a one-tenth inch objective, and then a micro-spectroscope attached to a camera, I have been able to obtain spectrographs of the absorptions of the Lumière and Warner-Powrie filters. But another method is quite as satisfactory, and very much less trouble. I have fitted in front of my spectroscope a small black wedge which gives a gradation of light along the slit, the variation in intensity running from 1 to 10,000, and consequently spectra photographed in this spectroscope show a series of hills and valleys, the summits representing the maxima of sensitiveness, and the valleys the minima. In order to find the spectral region of the filters, the screen plate is exposed in the usual way through the screen; after development, a complementary spectrum negative is obtained in which the area of the red filter is marked out by a blue-green patch, the area of the green filter by a magenta patch, and if there is any overlap, that overlap between the two is shown as violet. The area of the blue filter will be shown as yellow, and the overlap between the green and blue filters as a pure red. These spectra will also show, besides the spectral regions and the sharpness of the cut, the effect of imperfect filters transmitting undesirable portions of the spectrum, owing to the great fineness necessary in screen plates, which causes considerable difficulty in obtaining sufficient depth of colour in the plates to get satisfactory filters; this difficulty is one which has as yet hardly been realised, but it is one limiting condition for the fineness of the line. If the red filter transmits blue or violet, an extremely common defect, then the yellow representing the blue filter in the spectrum will not be a pure yellow, but a yellow-green. In the same way, if the plate is sensitised far into the red, and the blue filter transmits extreme red—a fault to which nearly all blue dyes are prone—then beyond the blue-green of the pure red there will be a patch of pure green; and if the green also transmits red this patch will be black. A patch of black in the blue-green region of the spectrum shows that the red is being transmitted there.

The practical effect of inaccurate filters is that if the red and green filters transmit blue, the defect which of all is most difficult to avoid, then pure reds will appear in the finished positive not to be reds at all but browns; and this brownish appearance of what should be scarlet shows at once that the red and green filters are transmitting blue. The magentas will in the same way appear purplish, and pure greens will tend towards a bluish green. Transmission of the red by the green and blue filters will give scarlet as magenta, will tend to make greens too yellow, and to show a slight purply shade in the blues. But this latter defect is neither as dangerous nor as difficult to avoid.

First Black Condition.

This is the title I have given to that condition to be fulfilled in the manufacture of a screen plate, which states that the screen plate when looked at as a whole must be grey or black, and not coloured in any way whatever. Of the screen plates I have seen, the one which best fills this condition is the Krayn plate, which is very slightly green; the Warner-Powrie plates are violet, and the Lumière Autochrome plate is very good indeed in this as in everything else, and is faintly pink. Unless this condition is fulfilled it is not possible for whites to be neutral tinted; hence its importance. The whole picture will have a veil of the colour of the screen plate itself. The grey is, of course, produced by the accurate adaptation of the colours of the areas of the differently coloured filters. In order to obtain with the Autochrome plate, for instance, the requisite grey, it has been necessary for the green particles to be 40 per cent. of the whole number.

Limiting Conditions for the Size of Screen-plate Units.

Apart from the increasing difficulties of manufacture in making plates with smaller units, there are two conditions which limit the size of screen-plate units. The first is the thickness of the dye substance itself; if this is equal to the diameter of one unit or to the width of one line, then any ray entering the screen plate at an angle above 10 degrees will be subject to considerable error, due to its parallax, it having passed not only through the unit through which it was intended to pass, but also diagonally through a portion of the adjacent unit before passing into its proper unit; so that a green ray for instance would pass through the top surface of a red unit and suffer considerable absorption before passing through the green unit itself; thus in Fig. 1, the green rays A and B are absorbed more or less completely by the red unit before passing through the green.

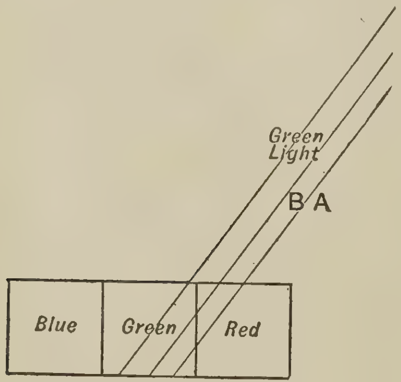


Fig. 1.

This condition is a serious limitation in practice; the Krayn plate, for instance, is at present made with lines about 170 to the inch, and of square section; if the lines are to be made 340 to the inch, then there can be only half the thickness of celluloid to hold the dye, which means that the dye concentration in the celluloid must be twice as great. When one reaches fine lines in gelatine, it is of great importance; for plain gelatine coating it is difficult to get a sufficiently deep screen with less gelatine than 1 cubic centimetre of a 5 per cent. solution upon 20 square centimetres, consequently the thickness of this coating wet is one-half millimetre; when dry, it will be 1-40th of a millimetre, which gives us 40 lines of square section to one millimetre, as our limiting fineness of lines, 1,000 to the inch.

The second limiting condition, which is of considerably less importance, is that imposed by the grain of the emulsion. The unit of development in a plate is a particle of silver bromide, and if any portion of a particle is exposed the whole particle becomes developable, so that if a grain of silver bromide lying almost entirely under a red unit had a small projection under a green unit, then on exposure to green light the projection would be affected, and the whole of the grain would develop, thus recording the green light as red. The diameter of the average grain of a plate can be taken as 1-1,000th of a millimetre, so that there would be 25 grains in the width of a line in a 1,000-line screen. The limit so fixed is obviously that of a very fine screen indeed.

As a matter of fact, a screen of regular distribution becomes invisible to the eye at about 600 units to the linear inch; and a screen such as the Lumière autochrome, having units 1-2,000th inch in diameter, would be absolutely grainless if it were not for the agglomerations of units which the screen frequently displays.

It is possible that a third limiting condition to the size of units may be found in the optical character of the screen unit itself. It has been stated that it is necessary that the refractive index of the sensitised film should be the same as that of the screen plate unit. Of this statement there has been no published proof, and it is difficult to see what effect alteration of the refractive index at the boundary between the unit and the film would have on the resultant plate, other than possibly an extremely slight loss of definition. It is, of course, necessary that with very small units the sensitive film should be in intimate optical contact with the screen. If the emulsion film be stripped from an exposed and developed Lumière plate, and again placed into contact with the screen plate, it is not merely impossible to get correct colour rendering, but it is almost impossible to get any colouring at all, owing to the difficulty of getting sufficiently good contact. This limiting condition could no doubt be worked out with regard to size of unit and difference of refractive index, and would justify the necessary expenditure of time.

Sensitising Conditions.

The conditions for making the emulsion for a screen plate are of interest. The emulsion must, of course, be of reasonably fine grain; but there seems no particular difficulty with regard to this. It is not true, as a general rule, that a fine-grained emulsion must be slow. It is quite true that a grainless emulsion must be exceedingly slow; but the variation in size of grain between a plate of speed—say 10, and say 150—is generally less than the variation which can be obtained by other alterations in emulsion making. The emulsion must be sensitised as far as possible to the whole spectrum. This can be attained to some extent by the addition of dyes, but probably fast screen plates in the future will be sensitised by bathing, that is, by immersing the plates, after coating, in a solution containing the sensitising dye. This bath can be adjusted to give either a maximum of red sensitiveness, or a maximum of green sensitiveness, or any ratio between the two. The sensitising condition to be fulfilled is that the bath should be so adjusted to the filters that the deposit beneath the red and green filters is equal in intensity. In the case of a bathed plate, with a properly adjusted bath, the blue filter will give nearly the same deposit as the red and green, and the introduction of a little black into the blue filter would probably eliminate the necessity of any further correction.

Unfortunately, however, it is not usually possible to attain always the same result in sensitising by bathing, or, for that matter, by sensitising in any other way, with sufficient accuracy to render it advisable to dispose altogether of a possible means of correcting later, so that probably it is better to allow the blue to exert rather more influence than it should, and to use a light yellow screen on the lens, or a compensator, as it is generally called, to reduce the blue to equality with the red and green; this will produce, if greys are photographed, greys on the plate, and it is easy to see whether the correction is complete by photographing a scale of greys, when any coloration will indicate bad correction.

This condition I should call the second black condition.

If the filters are of such a type that they transmit the extreme red through the green and blue filters, then it may be advisable to omit to sensitise for that region of the spectrum. If this is done, however, there will occasionally be difficulty in rendering pure deep reds, which may not record at all.

The Lumière Autochrome plate appears to have been sensitised with some form of emulsion which gives curves which can only be compared to those given by collodion emulsion, the sensitising dye being an isocyanin, possibly, from the curve, orthochrome T. Like collodion emulsion, the colour sensitiveness is very considerable, and the gap in the blue-green is very much more marked than would be the case if the same dye were put into gelatine. The sensitiveness of an Autochrome emulsion exposed in the sector wheel with the film side to the light, so that the sensitiveness is not measured through the screen, is 40 Watkins, this speed being then diminished by the screen and compensator to about 1 Watkins, and the density giving power is very low, density being obtained by intensification. The reason for this low density giving power is, of course, the thinness of coating which is necessary for reversal. If a screen-plate be coated with an emulsion of about 240 Watkins, which is sensitised by bathing, so that the multiplying factor of the screen itself is 20, and a compensator requiring twice the exposure is used, then we shall get a final effective sensitiveness of 6, which is about the limit of speed which can be obtained in a screen plate, unless new discoveries are made in emulsion making.

Production of Positives.

Inasmuch as the developed screen plate renders all objects in their complementary colours, it is necessary that the plates should be in some way transformed into a positive. The method adopted by Messrs. Lumière is to dissolve out the developed silver by the aid of a powerful oxidising solvent, which in their case is an acid solution of potassium permanganate; after solution of the silver, the silver bromide which has not been developed is blackened by the application of a developer after exposure to light, and a positive results.

In order that this method shall be successful, it is necessary that under the heaviest deposit of silver in the original negative there shall be no silver bromide; that is to say, that the sensitive film shall have been exposed and developed through to the back, which is only possible with a very thin film. Ordinary thickly coated plates cannot be reversed by this method. The necessity of using a very thin film carries with it a serious restriction as to the latitude which that film will have, because very thin films will not render great contrasts of light and shade, so that this in itself is an objection to the reversing method.

Another method of reversal, which was first suggested by Major-General Waterhouse, is development with a developer containing thiocarbamide, or one of its derivatives. General Waterhouse suggested finally tetra-thiocarbamide ammonium bromide used in a developer of eikonogen and lithium carbonate. This gives a very good reversal of a warm brown colour, with only slight fog on the high-lights, which can then be cleared by the use of the copper bromide reducer, the reducer changing the warm brown to a distinctly colder shade. Unfortunately, its action appears to be uncertain, and in the large number of trials I have made with it I am bound to say that I have made more failures than successes; moreover, I did not succeed in getting the final tone of my image to a satisfactory black. It is possible, however, that further work would remedy this matter, and make it possible to use thick films and a directly reversing developer.

With regard to the whole use of screen plates, one is bound to feel that, interesting as they are, and marvellous as has been the ingenuity shown in the production of the Autochrome plates, yet at present their application must be limited. No colour process which cannot be printed on paper can hope to appeal to the great mass of workers, and if the plates are used as transparencies, either in the hand or in the lantern, the density caused by the presence of the screen is so great that special viewing apparatus is desirable, a very great drawback indeed to the plates. What screen plates need, in fact, as their complement is a printing process such as a somewhat improved bleach-out emulsion which can be placed on paper, and on which the plates can be printed by an angling movement (for which reason one feels that line plates are those with the greatest future), or which can be placed on glass, thus forming whole-tone positives without the light-absorbing colour screen darkening the whole picture. C. E. Kenneth Mees.

THE SOCIETY OF COLOUR PHOTOGRAPHERS.

The following has been handed to us for publication:—

Ladies and Gentlemen,—I much regret that my circular to you of December 31 last asking for examples of colour work—prints and transparencies—for circulation in a new series of portfolios, etc., has not met with the ready response that one would desire. The matter has doubtless been overlooked by many of our members, but I venture to hope that this reminder will suffice, and that a number of examples will reach me in the course of a few days, so that the folios may be put into circulation without further delay.

MSS. giving detailed particulars of experiments or expositions of theories would also be acceptable additions to the portfolios, and would be of great educational value. The written criticisms and remarks which accumulate in connection with each entry in the folios make the collections exceedingly interesting and suggestive, and therefore of practical value.

Your co-operation in this matter will be esteemed.

Yours faithfully,
Henry J. Comley, Hon. Sec.

Surrey House, Stroud, Glos.
February 6, 1908.

New Materials.

Autochrome Chemicals. Supplied by W. Tylar, High Street, Aston, Birmingham.

To give amateur workers the opportunity of obtaining a set of the chemicals for the Autochrome process in quantity sufficient to make a first trial of the plates, the resourceful Mr. Tylar has issued a set at the price of 1s. 6d. It includes the necessary liquids and solids, and a circular of instructions.

New Apparatus, &c.

The Watkins Special Bee Meter for Autochrome Plates. Made by the Watkins Meter Co., Hereford.

In the "Colour Photography" Supplement for November 1 last Mr. Watkins pointed out the inefficacy of improving actinometers used in Authochrome work by employing orthochromatised paper in them. The result, he proved, would be to give indications still further wide of the mark, since such paper, exposed in weak indoor light, darkens relatively quicker, whereas the Autochrome plate is found to require relatively more exposure in such circumstances. Mr. Watkins has now introduced a special dial which can replace the ordinary one in the Bee meter. It is engraved to make an allowance such that 128 times the exposure is given under conditions of small diaphragm or poor light which theoretically require but 64 times, and other similar allowances are made in geometric ratio. The following are the instructions for use with the meter:—

Calculate with the same speed number for all lights and subjects, except that when time is calculated in minutes, instead of seconds, half the speed number must be used. The usual speed number is 2; but this should be modified if found desirable, 3 being preferred by some.

With Autochromes the rule seems to be to test the best light falling on the subject, and to ignore the illumination of the shadows.

Set the stop used against the speed number, and then against the light value (expressed in seconds), the exposure (in seconds) can be read on the outer scale.

If a smaller stop than $f/11$ is used, it is possible that the exposure scale will not be extended far enough. In such a case calculate with one-quarter the light number, and give five times the exposure indicated opposite it.

When judging whether a finished plate is rightly exposed, note that over-exposure gives the thinnest image, and under-exposure the densest, thus reversing the usual rule for negatives.

Be careful not to mistake under-development for under-exposure. The two and a half minutes for the first development is only right at the temperature named, and must be increased (up to five minutes) for cold weather.

Indoor Work.—It is necessary to take the actinometer time in minutes, and to read the required exposure also as minutes. When this is done, the speed of the plate must be taken as half its usual value.

Thus, if the usual speed is 2, it must be taken as 1 (note that if 3 is the usual speed, its half value on the outer scale is ¾, not 1½).

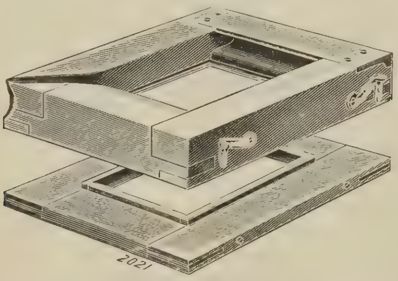
The usual Watkins plan of exposing actinometer and camera simultaneously should be followed, and if the stop used is *f*/8, or smaller, the darker or standard tint is used, and when the time of its darkening is observed, there is time left to calculate how long the camera exposure is to be. But if a larger stop than *f*/8 is used, the camera exposure may be too short to allow time to use the standard tint, and the paper should be darkened to the quarter tint only, and the time of this multiplied by four to calculate the camera exposure.

It is probable that this dial may be more correct than the usual dial when used for heavily screened orthochromatic plates.

Mr. Watkins gives the speed of the Autochrome for use out of doors as 2, for use indoors 1, numbers which our experience leads us to confirm; what he now does is to provide by calculation for the increase of the exposure in weak lights, whether caused by a small diaphragm or by enfeebled illumination. The new dial should be most useful. The price of the Bee meter with it is 3s.; extra dial for ordinary use, 3d. The Autochrome dials for existing meters are sold at 1s. each.

The "Campbell" Anti-frilling Dish. Made by Houghtons Ltd., 88-89, High Holborn, London, W.C.

The suggestion embodied in this "dish" was made at a time when the frilling of the Autochrome plate was very prevalent, and though little cause for complaint has been given with respect to this defect in the later batches, the dish nevertheless may be adopted by those who have reason to fear frilling of the emulsion, e.g., by the many persons who must be taking the plates abroad with them and may be compelled to develop them under trying conditions. In principle the "dish" is very simple: it consists of a frame in two portions, the upper (and deeper) being provided on its upper surface with a lip, and on its lower with a recessed space exactly the size of the plate to be developed. The rebate around the opening is faced with a soft pneumatic rubber cushion, against which the film side of the plate is laid and pressed firmly in contact by the remaining part of the frame. The plate thus forms the bottom of the dish, and its edges are protected from the developer and other solutions. Very little of these latter are required, and a well of sufficient capacity is provided to allow of examining the Autochrome by transmitted light. The device is, in fact, a revival of a dish used long ago for wet collodion.



The dish is made of hard cherry-wood well varnished, and successfully stood a test (of its water-tightness) of twenty-four hours' standing full of water, to which we subjected it. It is made quarter-plate, 5 x 4, and half-plate, at 4s., 5s., and 6s. respectively.

A Development Accessory for Autochromes, Panchromatic Plates, etc. Sold by R. and J. Beck, Ltd., 68, Cornhill, London, E.C.

This piece of apparatus consists of a light-tight metal box, through the corner of which water or any solution can be introduced by a funnel, whilst the bottom of the box is made double—to act as a light trap—and permits of any solution being discharged from the apparatus while the latter is in use. In the chamber itself is a platform on which a dish can be laid, the metal floor of the platform being turned up all round so as to retain the dish in position. The platform is mounted on a axle which is continued through one side of the box, and there provided with a pin which passes through its extremity and is stopped by two other pins fixed to the side of the box. This simple mechanism thus allows of the platform being given a see-saw motion within various limits, that is to say, the developing or other solution in the dish is gently rocked to and fro. One of the stop-pins, however, can be pulled out of the range of the moving pin, and the platform can then be tipped so far over that the solution is all discharged from the dish and escapes from the false bottom of the box down the sink, or into a larger dish in which the box may be placed.

It will be thus be seen that the apparatus allows of a series of solutions being applied to a plate while the "dark-room" is fully lighted. The developer itself can be applied through the funnel of the box, and distributed over the plate by keeping the platform rocking. In this way the inconvenience of timing the development of not only the Autochrome plate but of any panchromatic plate is overcome, and the plate can be flooded with water and brought out into the fixer in a bright orange light, if not in weak white light.

As supplied by Messrs. Beck the apparatus is well made in German silver, and should certainly be a most useful accessory in the development of both ordinary and colour-screen panchromatic plates. Its price in quarter-plate size is 25s. It is obtainable also for 5 x 4 and half-plate prices, 30s. and 37s. 6d. respectively. Messrs. Beck hold a circular descriptive of the apparatus at disposal.

◆

Colour Photography at Dresden.—A highly interesting exhibition has been held at the Photo-Kunst-Salon of Herr Oskar Bohr, Johannes Ring, Dresden. The specimens exhibited represent practically the only early ones extant, viz., the work of Joseph Albert, Obernetter, Hoesch, Leyde, etc., together with reproductions by those well-known pioneers of the art, Dr. Selle, Professor Krone, Sanger-Shepherd, Dr. König, Dr. Smith, Leon Vidal, and Szczepanik. The latest processes of three-colour carbon, as well as of the Lumière Autochrome, are evidenced by an extensive selection of excellent results, particularly photographs by Hugo Erfurth, Dresden, and Otto Werner, Riesa, which excel in beauty. The various exhibits, which possess very great intrinsic and historic value, are part of a collection representing the development of colour photography belonging to Professor Dr. jur. Freiherr von Weissenbach.

Trichrome Emulsion.—Messrs. Penrose and Co., 109, Farringdon Road, advise us of the issue of a new collodion emulsion, or, rather, set of emulsions, to be used for three-colour without filters, and having diminished "irradiation" or halation. The new emulsion is offered particularly for half-tone work, as it gives a sharp clean dot. Particulars of the new introduction will be found in the forthcoming issue of "Process Work," Messrs. Penrose's bi-monthly journal, obtainable free.

"Once More."—Raymond W. Peirce, a Philadelphia photographer (according to the "Bulletin of Photography"), has solved the print in colour problem. "Some beautiful examples are shown us, made both on Velox and enlarged on ordinary bromide papers, and the true colours of nature depicted. Mr. Peirce has been experimenting for years with the process, and the final results were secured on New Year's Day. His process is different from any other process that has been exploited heretofore, and although in its infancy the samples shown us excited admiration."

"Science Progress" (London: John Murray, 5s.) contains, in its January issue, a contribution by Mr. Chapman Jones, on "The Photography of Colour," in which the writer first treats of recent methods of colour photography, the so-called "photochrome" of Seebeck, Becquerel, and others. He next reviews the analytic-synthetic methods of three-colour work, including the recent developments with screen-plate processes. Anyone who would have a careful conspectus of the technical basis of colour methods will do well to peruse the article.

No. 15. Vol. II. MARCH 6, 1908

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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SOME MEASUREMENTS OF UTO PAPER.

Of all the suggested processes of colour photography there is none which seems to promise greater things than the "bleach-out" process; and it was from the point of view of personal interest that I made a series of measurements showing the actual nature of the bleaching out which goes on when Uto paper—the mixed black bleach-out paper prepared by Dr. J. H. Smith—was exposed to light of different colours.

On showing these to Dr. Smith, he suggested that they would probably be of interest to the general public, and that they should therefore be published.

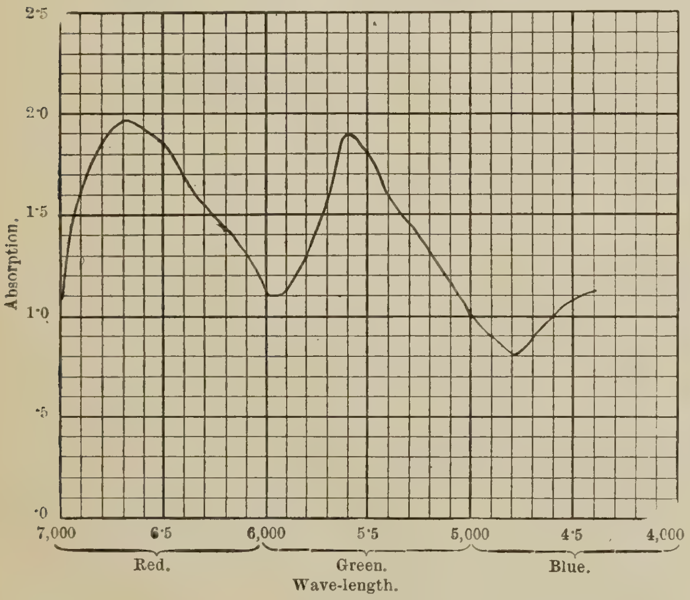
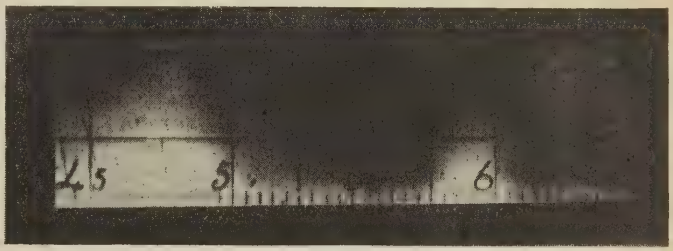


Fig. 1.

The "mixed-black" process is one which offers considerable facilities to the experimenter, and it is a matter for astonishment that so few observations have been published upon it. The work of Worel, Neuhauss, Szczepanik, Smith and Merckens comprises almost all the original work which has been published.

A bleach-out paper consists of a mixture of three dyes, the colours of these dyes being the same as the printing colours used in the subtractive process of colour photography—i.e., they are the complementaries to the primaries, being minus red, blue-green, minus green, magenta; and minus blue, yellow. Dyes are chosen of these three colours which are fugitive in the presence of light, and chemicals are added, such as anethol and hydrogen peroxide, which increase their sensitiveness to light. The dyes and their sensitisers are mixed together, in the case of Uto paper, in a collodion emulsion, and are coated to form a greyish-black surface.

The first point of interest was found on measuring the light reflected from the unexposed paper. I used for the curves which I publish here some earlier paper, which was not very dark in colour, so that it was fairly easy to get measurements in the spectrophotometer. The actual method of measurement was to place the paper squarely facing the top half of the spectrophotometer front,* lighted from the side by a powerful Nernst burner, the light reflected from the glossy surface being at such an angle that it could not possibly enter the photometer. A piece of white paper was put in the same way opposite the lower half, and the comparison was therefore made throughout between the Uto paper and this white paper.



Reflection spectrum showing reflection and absorption maxima.

Fig. 1a.

The result obtained is shown in Fig. 1. This curve shows clearly that, instead of the white light reflected from the Uto paper being of the same composition as that reflected from the white paper, it consists actually of two maxima of light with three absorption maxima between. These three absorption maxima obviously correspond to the three dyes; the first maximum, at 6,700, corresponds to a blue-green dye; it might, indeed, be methylene blue, though this would probably give a double maximum. The second maximum, at 5,600, corresponds to a magenta dye; it might be erythrosine, though from the curve one would doubt it.

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* For description of the Huefner spectrophotometer used, see "Phot. Journ.," July, 1904.

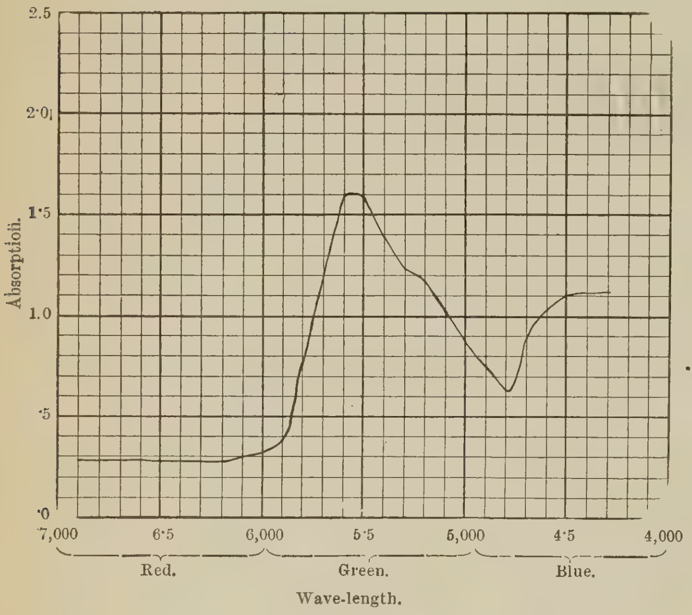


Fig. 2.

It is not possible on a spectrophotometer used in the ordinary way, and with the small amount of light which is available when reflecting light from black paper, to measure far into the violet, and so we have but an indication, and not a measurement, of a third maximum between 4,000 and 4,500, corresponding to a yellow dye. Thus our very first measurements show that the Uto paper does consist of three dyes. In order to obtain a confirmation of this, a piece of the new improved paper (a piece which Dr. Smith said was the best he had made) was fixed out by washing in benzole, and put squarely in front of the slit of the wedge spectrograph. A powerful arc lamp was used to illuminate it, and an exposure of about two hours, on a Wratten "Panchromatic" plate, was given. The paper bleached very slightly and fairly evenly in the course of the exposure. In spite of the difficulties, two maxima of reflection are distinctly visible, and three absorption bands (Fig. 1A).

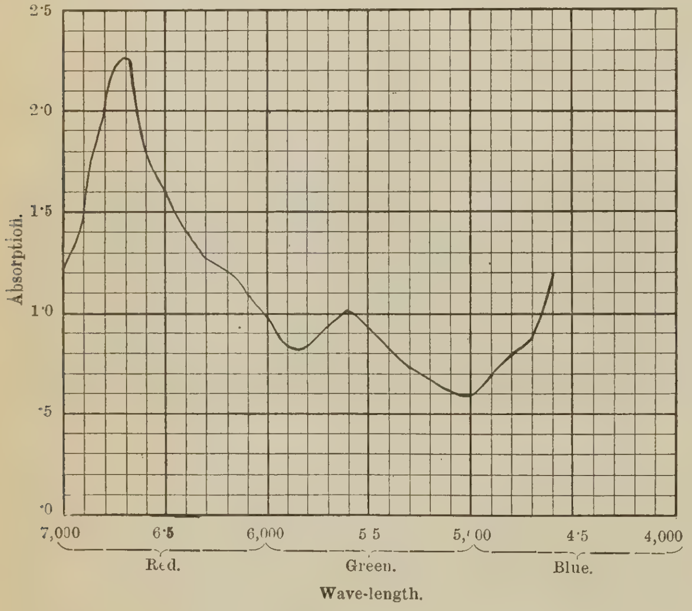


Fig. 3.

Since, then, we can show, by measuring the reflected curve, that the paper does actually consist of three dyes, it was thought of interest to measure the curve reflected from paper which had been bleached under various screens. The paper was first exposed under a red primary screen. It took on a fairly bright red colour. On measuring the light reflected from this, it was found, as is shown in Fig. 2, that the red absorption maxima due to the blue-green dye had been entirely destroyed; that is to say, the blue-green dye had been bleached out; and since the paper now only exhibits absorption in the green and blue, it naturally appears bright red.

From an exposure under the green screen the curve of Fig. 3 was obtained:—

This shows the absorption maximum in the red, due to the blue-green dye, and in the blue due to the yellow dye; the green absorption having been entirely destroyed, giving the green colour. Under the blue screen, a corresponding alteration took place: the result was less satisfactory both visually and in the curve, owing probably to the lower absorption maximum of the yellow dye.

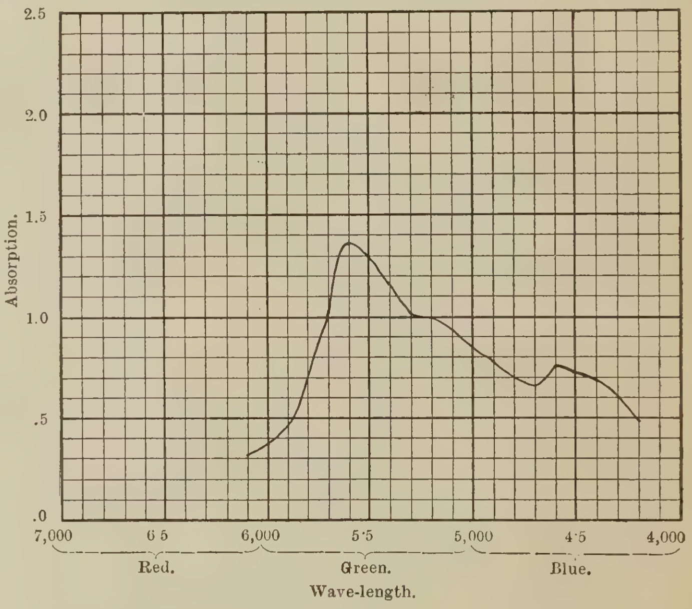


Fig. 4.

A very interesting curve is obtained by a measurement of the paper which has been exposed under a minus-green screen, i.e., a magenta screen. This shows the absorption maximum in the green only, the blue and red maxima having been destroyed. Curve 4. In the same way, yellow destroys the green and red maxima, leaving the blue maximum. In this way the whole mechanism of bleach-out paper is made clear. The three maxima of absorption are due to three dyes originally existing in the paper; any one maximum can be bleached out by light of the colour which is absorbed falling upon it; that will produce one reflection region and two absorption regions in the spectrum, and we shall get a primary colour: or two maxima can be bleached out, leaving only one absorption band—when we shall have a complementary colour; or all three can be bleached out, when we shall get white, while the intermediate stages will give us various compound tints. C. E. Kenneth Mees.

A NEW COLOUR-SCREEN METER.

[The following paper read before the Franklin Institute, Philadelphia, by Mr. F. E. Ives, describes a further simplification of the colour-meter worked out by Mr. Ives and described in our pages some five months ago. Mr. Ives now dispenses with the diffraction gratings, and obtains his mixtures of colours by simpler optical means of employing fixed colour-filters.—Eds. "Colour Photography" Supplement.]

The nearest approach to a universal colour-meter which is now commercially exploited for use in the arts and industries employs arbitrary standards and scales, and different sets of standards for different arts, trades, and industries. The numerical readings are of a complicated character, with an indefinite qualification of "brighter than standards" or "duller than standards," and the percentage values are quite unreliable because of the introduction of an indefinite number of refracting surfaces.

By an adaptation of the fundamental principle of the Maxwell "colour-box," substituting a special photographic diffraction grating for the prisms in Maxwell's device, and making the instrument "direct vision" and compact, with slit adjustments controlled from a point near the eye, I made it possible without further complication to match, measure, and record all such colours as can be found in the arts and industries. My diffraction colour-meter was demonstrated on April 25 of this year, and the paper published in the "Journal" of this Institute in July.*

I stated in my paper that some difficulty had been experienced in perfecting mechanism for giving accurate percentage readings of the opening of the three narrow and unequal slits. This was successfully accomplished, but there was reason to think that the correct adjustments might not always be maintained, and that users of the instruments might sometimes neglect to verify the adjustments before taking measurements. Although this, being a purely mechanical detail of the instrument, might very probably be satisfactorily perfected by a mechanical expert, it seemed to me to be worth while, before going any further with it, to see how nearly I could come to the same results by substituting three comparatively large rectangular openings covered by special colour-screens for the slits and grating, and mixing the colours by an optical device, thus permitting of the use of much less delicate "slit" mechanism, and at the same time making it impossible to use wrong standards by shift in the spectrum.

I finally succeeded in obtaining practically the same results as with the diffraction colour-meter, without material alteration of size, general appearance, method of application or facility of adjustments, and with the further advantage that a much wider eye slit is used and the light is of exactly the same colour at both edges of it.

Optical Mixture of Colours.

Although this instrument differs very materially from its predecessor, it will be seen later that it represents a further evolution of the same idea. The two most novel elements in this device are, (1) a nearly juxtaposed set of three rectangular colour-screens which transmit respectively and exclusively the spectrum rays A to C 1/4 D (fundamentally pure red), a remarkably narrow and well-defined band in the green with maximum at *b* (wave length 517) and from F 1/2 G to H (blue violet), and (2) a revolving wheel of convex lenses which optically mixes these colours to the eye, in the field of the instrument. For comparison purposes, a laterally placed clear aperture is provided, transmitting light which is bent into the axis over one half of the field by a wedge prism and spread across it by the optical mixing wheel in the same manner as the three colour.

A Permanent Green Screen.

It would have been impossible to produce a satisfactory device of this character but for the discovery, as the result of much experiment directed to that end, of means for producing a permanent green colour-screen transmitting very freely but exclusively the spectrum rays of a narrow band over *b* in the spectrum. The purest green glasses transmit a diffuse band of spectrum green very many times too wide, and therefore far too impure to compete with the narrow band taken from the spectrum in the Maxwell colour-box or the diffraction colour-meter. The green of this new screen is of such definite hue and purity that it serves the purpose practically as well as a sharp band taken out of the pure spectrum by prism or grating. It is also a permanent colour-screen, showing no trace of change after long exposure to summer sunlight, and the colour is not changeable by adjustment, like the changes which would result from any accidental shift in a spectroscopic device. Of course, the red and blue screens also possess these merits, but their production in my hands involved no extended experiment or special difficulty.

A Standard of Colour.

Maxwell measured the colours of the prismatic spectrum in terms of red at C, 1/4 D, the green at E, and the blue at F 1/2 G. Later authorities have generally chosen a green at *b*, or even a little further towards F, and in some cases a blue also nearer the F than Maxwell's. The green at E will not mix with the blue at F 1/2 G to absolutely match the spectrum at F, and the green at *b* will not mix with the red to absolutely match the spectrum at D. It is necessary, in both cases, to add a trace of white to the pure spectrum colour in order to match it with the mixture. The green at *b* will give better average values throughout the spectrum than the green at E, and a blue nearer to G is necessary to match purples consisting of fundamentally pure red mixed with spectrum indigo-violet.

The colours which I have adopted have as nearly as possible the hue values of the spectrum at C, *b*, and G, and that this triad is the best obtainable for a colour-meter to measure up all such colours as are to be met with in the arts and industries is absolutely proved by experiment on such colours.

A Maxwell colour-box, using Maxwell's primaries, failed on deep aniline violets which the screen colour-meter would match, and by reason of the yellower hue of Maxwell's green it was no better for peacock blues than the screen meter; both would match all such peacock blues as are to be found in the arts and industries, with a difference only of percentage readings. Orange hues containing no trace of white cannot be exactly matched by mixing the *b* screen green with the red, but the purest of such colours in fabrics, etc., reflect enough white light superficially to make a perfect match possible.

By means of this colour-meter, every colour to be found in the arts and industries can be quickly and accurately matched, measured in terms of three definite spectrum hues, recorded by three numbers, and reproduced for observation or matching at any time by simply setting the instrument to the recorded number and directing it to a background of standard white. It is not even necessary to introduce the letters R, G, B in the record, since if the numbers be given in the same order, the first is always to be taken as red, and the last as blue.

Frederic E. Ives.

"B.J.," August 16, 1907, p. 619.

AUTOCHROME NOTES AND ITEMS.

Dr. Jaroslav Husnik gives in the "Photographische Korrespondenz" his experience of the Autochrome plates. We quote the chief points in a lengthy paper. Development should not take longer than the prescribed time—two and a half minutes—though errors in exposure may be corrected by increase of ammonia or bromide, and a corresponding decrease or increase in the time of development.

The second development Dr. Husnik regards as most important. It should be longer than advised by the makers—six-seven minutes in all—particularly if the light to which the plate is exposed is poor. To this cause is ascribed the majority of failures, for if any silver bromide is not affected it will not be reduced by the developer, and will dissolve in the fixing-bath.

That intensification can be omitted, as has been stated, the author will not admit, except in special cases of extreme contrasts. The highest lights, he points out, are represented by the filter elements which absorb as much light as the half-tones of an ordinary transparency. The result of this is that the variations between lights and shadows are much smaller, and the gradations are at least half those of an ordinary transparency. It is therefore necessary to make the shadows very deep.

Another point is as follows:—The highest light of a white object must naturally, in the first development, be represented by total reduction of the silver bromide to metallic silver, which is dissolved by the acid permanganate bath. It will therefore be represented in the final picture by the filter elements alone. As these latter do not give the visual impression of white, but are a distinct red tinge, pure white cannot be accurately reproduced, and all other delicate half-tones will be also tinged with red.

With sufficient exposure for the shadows, the lights will always be over-exposed, as in ordinary black and white work; but this is much more troublesome with Autochrome plates, as not only detail, but also colour, is lost, and the finest tints will become pale and tinged with red.

Dr. Husnik points out that he has often found panchromatic plates vary considerably in colour-sensitiveness; one batch might require a ratio of $1:2\frac{1}{2}:8$, whilst the next would require $3:1:4$ for the blue, green, and red filters respectively. Further than that, he contends that the same emulsion will alter considerably by keeping. He is here speaking of the plates as used for three-colour work with separate exposures, and advances the statement that MM. Lumière have not succeeded in making an emulsion which invariably has the same colour-sensitiveness. As the ratio of exposures with the Autochrome plate is absolutely fixed by the coloured starch grains, it becomes necessary at times to use a deeper yellow filter in order to compensate for the variation in colour-sensitiveness of the emulsion.

As regards reproductions of Autochromes in three-colour Dr. Husnik is convinced that in many cases an Autochrome positive may take the place of the object itself in reproduction work, particularly for articles of commerce; the results are less satisfactory in copies of paintings. Practical experience in his works has proved that with the correct line-screen excellent three-colour half-tones can be obtained from Autochromes; the starch-grain becomes less noticeable—in fact, the reproduction is preferable in this respect to the Autochrome.

Two Varnish Formulæ by Valenta.

Professor Valenta, of Vienna, gives in the current issue of the "Photographische Korrespondenz" the results of his examination of Autochrome plates, in the main confirming all that has been said. The diameter of the grains he finds to be from 0.01 to 0.014 millimetres. The interspaces are filled with a black pigment. The emulsion is a gelatine one. Unsatisfactory spectra, but good reproductions of natural colours are obtained. Frilling he ascribes, in most cases, to variations of temperature in the solutions, which should all be at the same temperature, and that not above 60 deg. Fahr. Too strong ammonia solution will also tend to frilling. An edging of hard paraffin wax he finds to be the best preventive. When frilling does take place it is advisable to rinse the plate and put it away in a well-ventilated drying box till dry, and then continue with the treatment. Results may often be improved by reduction or intensification, and the ordinary ferricyanide and hypo reducer is satisfactory; for intensification, the ordinary mercurial one may be used, but the mercury solution should be half-strength. In place of the dammar varnish suggested by the makers, either of the following may be used:—

Carbon tetrachloride	100 ccs.
Gum dammar	10 gms.

Dissolve and filter, and, if too thick, thin down. The following is better:—

Carbon tetrachloride	100 ccs.
Gum dammar	2 ccs.
Manilla copal (powdered)	5 ccs.

Heat to boiling point for a few minutes, and then filter hot. Incidentally he remarks that this is excellent for ordinary negatives, and takes the retouching pencil well.

The Sanger-Shepherd Process.—At a meeting of the Central Technical College Photographic Society, held on February 26, Mr. E. D. Doncaster gave a lecture on "The Latest Improvements and Applications of the Sanger-Shepherd Process of Colour Photography," Professor Armstrong taking the chair. The lecturer first gave a short account of the principles on which the process is based. Great improvements have lately been made in the panchromatic plate by Mr. Sanger-Shepherd. The exposure through the red filter now requires no longer than that through the blue. The three exposures are made side by side on one plate through the three-colour filters, the colour of which has been accurately adjusted to suit the plates. The dark slide containing the plate and colour screens is moved successively into the three positions by a rack and pinion movement, thus giving a maximum speed in making the exposures, with a minimum of friction. The lecturer then showed a very interesting series of beautiful slides made by this process; among the most remarkable was a photograph of some live butterflies and one of a golden eagle. There were many very effective still-life studies, but there were also examples in every class of subject—landscapes, portraits, etymological specimens, microscopic subjects, stained glass windows, and old illuminated manuscripts. The distance was particularly well rendered in the landscapes, and the greens, which used to give more trouble than any of the other colours, left nothing to be desired in most of the slides, many of which were produced by amateurs, some very good ones being "first attempts." The blue component of the transparency is made on an ordinary lantern-slide, which is then toned blue with iron. The pink and yellow transparencies are printed side by side on a strip of celluloid film, coated with gelatine and silver bromide, sensitised as for carbon tissue. These are developed in warm water, the silver dissolved out with hypo, and the plain gelatine images stained with the pink and yellow dyes. Mr. Doncaster concluded his very interesting lecture with a short description of several paper printing processes, namely, the ordinary carbon transfer process, the Rotary stripping films, and the Shepherd and Bartlett process of printing from stained gelatine reliefs, the advantage of the last-mentioned being that pure dyes could be used instead of the less pure pigments. The various pieces of apparatus described during the lecture were passed round for inspection. Professor Armstrong thanked Mr. Doncaster for his very able lecture, remarking that the process was most practical, and one that produced extraordinarily good results. The meeting was concluded with a hearty vote of thanks to the lecturer.

MEASUREMENTS OF THE AUTOCHROME PLATES.

[Numerous as have been the papers in the English and foreign Press on the Autochrome plate none, perhaps, have supplied the exact measurements which have been published in a recent issue of "Popular Astronomy," by Mr. R. J. Wallace, of the Yerkes Observatory. Mr. Wallace's work is done with such invariable thoroughness that the results of his examination of the Lumière plate cannot well be omitted from a systematic record of the technical literature of colour photography.—EDS., "Colour Photography" Supplement.]

TAKING up the first coloured layer, a microscopic examination gives the granules a mean diameter of 0.014mm.,[1] and which, with polarised light, show the characteristic black cross. With the aid of the spectroscopic eyepiece the absorption spectra of the individual colours may be observed. Photography of the spectrum, however, supplies all the information necessary upon this point. Further reference will be made to this presently.

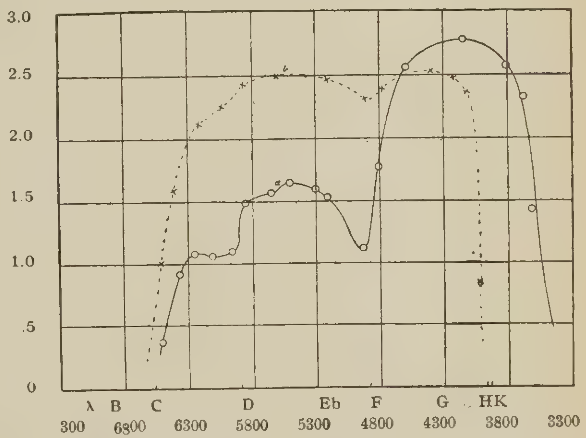
By counting the coloured granules contained in various selected areas, one may reach a conclusion as to the relative distribution. From this observation it results that the red (or blue) granules are about equal in number, while the green are in excess in the ratio of about four green to three red and blue. Treatment of the colour film with hot water (temp. 90 deg. C.), and occasional examination under the microscope, shows that the blue colour is the most soluble, next the red, while the green granules retain their colour for a considerable length of time. Evidence of the greater solubility of the blue-violet is shown by the general yellow tint which the plate acquires after but a very brief immersion in the hot water, which indicates the removal of the blue-violet colour in quantity too small to be indicated by examination of the individual granules. Upon treatment with cold water the green granules appear to be the first to discharge their colour, followed by the red, while the blue appears to be quite persistent. No difference could be observed in the mass tint after soaking in cold water for thirty minutes. Ether dissolves the varnish of the starch layer so that isolated granules may be observed individually; there is no influence, however, upon the colour. In alcohol the green colour is slowly discharged, and the colour film frills away from the glass support in one continuous sheet. Dilute ammonia discharges the colour slowly in the order of red, green, and blue. In acid permanganate of potass all colours are equally (but slowly) discharged.

Measurements to determine the absorption coefficient of the colour-film and glass, made in the polarising spectrophotometer,[2] gave a mean value of 16.6 deg., which equals a H. and D. density of 1.0882. Measurement of the thickness of this coloured starch layer gives a value of $\frac{6}{10,000}$ inch $= 15.24\mu$.

The sensitive film which is coated upon the colour filter-layer is of extreme tenuity, measuring in thickness slightly less than 4.0μ (= .00015 inch). With the ordinary dry plate film of Seed "27" there is a measured thickness of about 31 μ (= .0012 inch). This extreme thinness of film precludes the consideration of much latitude in exposure, and this is borne out in practice. The sensitive film itself is not entirely soluble in hot water, nor does it dissolve in an ether alcohol mixture. Stenger[3] is of opinion that the sensitive film is composed of a combination of gelatine and collodion, which, from the observations of the writer, is considered as probable, even although the further treatment with ether-alcohol failed to dissolve it. The reduced "silver grain" of this film is of exceptional fineness for a fast emulsion, giving upon measurement a mean of 0.5 to 0.8 μ for individual "grain" particles, while mean "group particles"[4] measure 1.6 μ to 2.0μ; these measurements were, of course, made prior to intensification.

Tests for determination of selective sensitiveness were made by exposing an Autochrome plate with the film side towards the lens, to a series of nine differently timed exposures to the spectrum of diffused daylight, in the "standard" spectrograph,[5] the sky effect remaining apparently constant throughout. Examination of the resultant negative (developed in pyro-ammonia) shows a heavy drop in the blue-green sensitiveness, which extends from λ4860 to nearly λ5180 (F—*b*). A second drop is apparent from λ5890 (D) to λ 6200, the sensitiveness ending (with normal exposure) at about λ 6500 minus.

From measurements on this plate, the accompanying curve Fig. 1 (*a*) was plotted, and examination of it shows that, regarded from a "panchromatic" standpoint, the emulsion leaves much to be desired. The sensitiveness-curves shown herewith are not in agreement with those plotted by Stenger, who shows a much higher χ value $\left(=\frac{\lambda\ 4100}{\lambda\ 5600}\right)$ than does the present writer. In Stenger's sensitiveness-curves the density value of the red at λ6100 is almost identical with the density of his blue at λ 4200. The lack of accordance arises from the fact that Stenger made use of an artificial light source (Nernstprojektionslamp) which gives a false intensity to the red, while the present curves are from negatives exposed to a grey foggy north sky.[6]



The vertical of G lay so near to the line "4300" that it coincides in the reproduction.

Fig. 1.

Exposures were also made upon the film side through the Lumière compensation filter, and the effect obtained is shown by the dotted line, *b*, in the same figure. The rather abrupt drop in the blue-violet, and the general improvement in the orange and blue-green will be readily noted. The adjustment of this filter evidences much care, and it would be indeed difficult to improve upon, either in individual or commercial manufacture.

A series of spectrum exposures were now made with the light passing through the colour film, but *without* the interposition of the compensation filter. The plate was handled throughout according to the instructions by Messrs. Lumière. With under-exposure the action is first visible in the violet at λ 4,100, which, as it is to be expected, is shown as a bright blue, while with increased exposure the green at λ 5,270 is the next colour to show, followed almost immediately after by an action at λ 5,850, which region is shown as a deep red instead of a bright yellow. With increased exposure the blue-violet from λ 4,300 to λ 3,900 becomes diluted with white, while the green and red regions are extended and brightened, but showing at what may be termed "normal exposure" two distinct absorptions in the blue-green and yellow, as indicated in *a*, Fig. 2. The ultra-violet region to λ 3,400 is, of course, evident throughout, and is shown as a bright blue.

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[1] This is in practical agreement with Wall, who gives a mean of ·015 mm., "British Journal" Colour Photography Supplement, p. 57, 1907.

[2] See "Astrophysical Journal," vol. 25, 124, 1907. "Studies in Sensitometry" I. by the author.

[3] "Zeitschrift für wissenschäftliche Photographie." Band 5, p. 374, 1907.

[4] "Astrophysical Journal," vol. 20 p. 113. 1904.

[5] For description of this and other instruments for sensitometry see former paper "Astrophysical Journal," vol. 25, p. 122, also vol. 26, p. 12, 1907.

[6] (Die Autochromplatte Erich Stenger. Zeitschrift für wissenschäftliche Photographie, 5, 376. 1907.)

There is difficulty in depicting graphically the Autochrome reproduction of the spectrum, inasmuch as the colours do not correspond correctly to the wave-length. For example, taking the blue region from λ 4,860 (F) to λ 3,933 (K) in the ultra-violet, visual observations of the spectrum show that the hues embraced are pure blue, indigo-blue, and violet. In the Autochrome reproduction, on the contrary, we have first a drop in the blue at F, just where it should show the purest, which is due, first, to the insensitiveness of the emulsion for that region and, second, to the lack of overlap (with normal exposure) in the green and blue filter transmissions, which results in the introduction of black at this point, hence a lowering of the luminosity curve. The change in hue with the wave-length, which gives the delicate blend to indigo blue and then to the spectral violet, is absent in the reproduction, being represented instead (after recovery from the insensitive band at F) as a blue of even hue throughout. The same criticism applies to the green and red regions. That delicacy and charm of graduated colour which makes the solar spectrum the most magnificent phenomenon in the domain of science is utterly lacking in the reproduction, which appears crude by comparison. Hence in the graphical representation of the coloured spectra be it understood that approximate luminosity alone is estimated, and not hue.

A second series of exposures made through the colour film of the plate, but with the interposition of the compensation filter, presents particular interest, as not only fulfilling the requirements demanded by the inventors, but as supplying authoritative information relative to the selective transmission of the colour granules. With under-exposure the region at λ 5,850 is the first to show action, but instead of being represented as a pure yellow is again depicted as a deep red. This is to be expected when we consider that the additive formation of yellow is accomplished by the mixture of red and green, and that therefore yellow can only be represented when there has been sufficient exposure to extend and unite the action of the red and green regions.

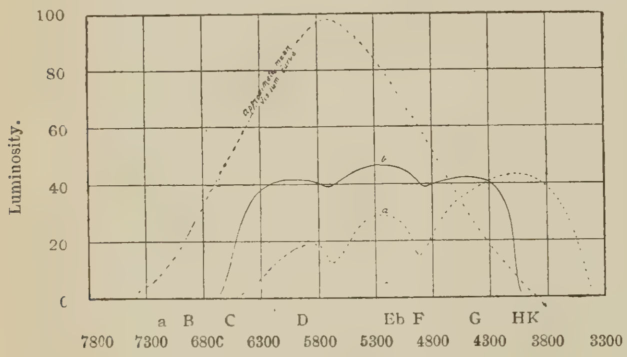

Fig. 2.

The initial action in the red is closely followed by that in the green at λ5,270, and then by the blue at λ 4,500. Increase in exposure results in a widening of the colour bands, but without perceptible change in hue or purity (although the luminosity is increased), until at "normal exposure"—that is to say, at the exposure which represents the maximum allowable, without the introduction of white to the colours, there is formed by the mixture of the green and red bands a rather dingy orange-yellow, in place of a pure yellow of high luminosity. In the opposite direction the admixture of the green and blue colour bands results in the formation of an "indigo" of low luminosity in place of a pure blue-green, together with a faint trace of over-exposure in the blue at λ 4,400—4,500. As a reproduction of the spectrum the result is not good, and can be considered as a rough approximation, while the size of the colour particles (which in this consideration is equal in effect to coarseness of "grain") precludes the registration of all but the more prominent Fraunhofer lines, which are therefore, to a large degree, independent of the slit-width; for when it is remembered that the action throughout either of the three-colour regions is composed of (almost solely) colour particles of one hue, occupying, therefore, less than one-third of the area,[7] we see that practically we are reduced to the necessity of considering the result as formed by "group particles" of "grain" of about sixteen times the size of the "grain" particles of an ordinary fast plate.

Even with extreme over-exposure it does not appear possible to obtain a pure yellow, and this is corroborated by results in ordinary copying, where the yellows lack luminosity. From the curve shown in *b* (Fig. 2) it will be seen that the limits of the visible spectrum are much restricted, being cut off rather abruptly (with normal exposure) at λ 4,150 and λ 6,500. The effect of increased exposure is the formation of a pinkish-white, showing first in the regions corresponding to the primary action with under-exposure, and, with increase of exposure, extending in the same manner as does the colour effect.

The spectrum result obtained by the action of the light through both the compensation filter and colour filter is, of course, a record of the transmission of the individual colour filters which form the mosaic layer. As has been pointed out by Abney,[8] the filters show isolated transmissions, with decided overlap, as exposure is increased, and occupying a position midway between the theoretically perfect "taking" and "viewing" filters. As a reproduction of the spectrum the Autochrome is ridiculous, while in practice, in the copying of multicoloured objects, the results are truly marvellous in their fidelity.

Copies of various colour-charts were also made, and when the exposure was such that white was reproduced with the closest approximation, examination of the individual colour patches show the great difference in results dependent upon the photography of *pigment* colours as against *spectral* colours. Under the microscope the yellow region of the spectrum reproduction shows the action confined entirely to the red and green granules, the blue granules being represented by black, while in the case of the reproduction of the yellow pigment patches the blue granules are also easily visible. The result is a strong uplift to the luminosity of the yellows by the introduction of white.

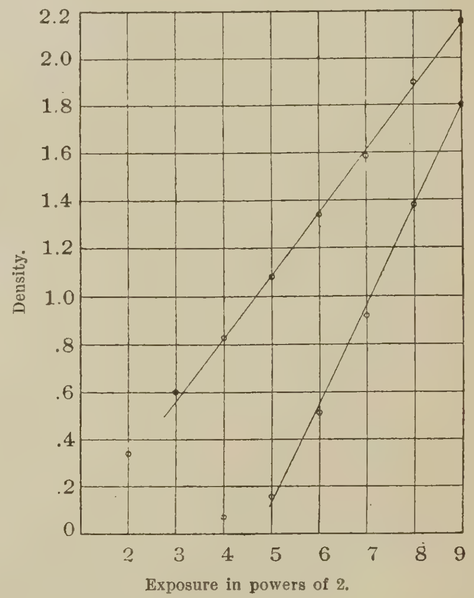

Fig. 3.

Inasmuch as the highest light obtainable upon the plate is represented by the admixture of the three colours *plus* the black pigment, it will be seen that white is existent (in reproduction) simply as an effect of contrast. The reproduction, therefore, of any coloured object is equivalent in truth to viewing that object through a light neutral grey glass.

Simultaneous exposure of two "Autochrome" plates in the revolving sector-disc machine to diffused daylight—(*a*) upon the face of the sensitive film, and (*b*) through the colour film—give, upon measurement, practically identical gradation curves.[9] While the exposure of an "Autochrome" plate (film side) and a Seed "27" give measurements which, being plotted, result in the curves shown in Fig. 4. Duplicate plates supply confirmation of the higher density factor of the Autochrome plate for short development, although with lengthened development these conditions are reversed. The extraction of the relative speed difference gives a value of 22.2 (=4.49 times) in favour of the "27." For the total speed difference, however, there must be added the absorption coefficient of the coloured layer and glass, and also the multiplying factor of the compensation filter, which reduces the total speed value of the plate to one-sixtieth of the Seed "27."

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[7] The black blocking out pigment must also be considered.

[8] Autochrome. Sir W. de W. Abney. Journ. Royal Phot. Soc. 37, 252, 1907.

[9] Development of both plates was with pyro-ammonia for two and one hal minutes at 20° C.

To one who has worked with the problem of colour reproduction by means of superposed films, the first view of an Autochrome is somewhat disappointing in so far as brilliancy is concerned, but when allowance is made for the reduction in luminosity (which practically amounts to a lowering of the entire tonal scale), the charm of the result in the delicacy of portrayal is a source of growing enthusiasm.

One is led at first sight to rather dread the somewhat extended operations necessary to the production of the finished result, and this fear is rather enhanced by the amount that has been written regarding the tendency of the film to "frill," and thus ruin the result. Personal experience, however, leads emphatically to the statement that the process is really absurd in its simplicity when compared with other methods, and in the hands of the writer absolutely no trouble was experienced with "frilling," and that, although all of the exposures handled (about fifty) were upon plates which had been cut from larger sizes. It takes in the neighbourhood of from twenty to twenty-five minutes (from the time of the completion of the exposure) to produce the finished result.

The value of the plate to the astronomer or spectroscopist is at present not apparent to the writer, but to the student of photographic science, and to that great body known as "general workers," there has been placed ready to hand a means of reproducing the many hues of art or nature by a method whose exquisite beauty calls forth nothing but the highest encomiums.

Time will, of course, bring many improvements, but the process, even as it stands now, is a lasting monument to the capability, perseverance, and commercial enterprise of M. Lumière et ses fils.

Robert James Wallace.

THE KRAYN SCREEN-PLATE PROCESS.

Dr. E. Stenger, who is the second in command under Dr. Miethe at the Berlin Technical High School, contributes to the current issue of "Photographische Chronik" an article on the linear screen-plates at present under discussion. After some remarks on the Smith process and the Warner-Powrie plate, which contain little that has not already been published in this country, Dr. Stenger proceeds with some conclusions as to the Krayn screen-plate, which appear worthy of translation. He first refers to the patents of the year 1899 by Otto N. Witt and R. E. Liesegang in each case for a process which is, in its general aspects, similar to that of Krayn, and he quotes Dr. Kieser, from the "Photographische Industrie," 1897, p. 1,479, who has pointed out that Herr Liesegang was the first to suggest a line-screen of this character. According to Dr. Stenger, the manufacture of the Krayn line-screen is as follows: Three coloured celluloid blocks are prepared of blue, green, and red respectively. These are cut by means of suitable machines into thin films, which are then laid one on the other in the repeated sequence blue, green, red, and from the three colour blocks thus built up sections are again cut in a perpendicular direction. The films thus produced form the banded screens, which thus consist of coloured transparent celluloid. The fineness of this screen depends on the thinness of the large sheets of celluloid of which the block is composed. Up to now the films of the Deutsche Raster Gesellschaft have been of seven lines per millimetre (180 per inch), but it is hoped, by improving the machine, to prepare screens of one-third this thickness—that is to say, screens will be made of twenty coloured lines per millimetre (500 lines per inch). These celluloid screens dispense with a glass support. They are coated direct with emulsion, and may be purchased and rendered sensitive by the plate-maker. The present coarseness of the screens is such that the making of small-size pictures is hardly feasible, but with a picture of 7in. by 5in. the linear formation commences to be less noticeable. Up to now the Deutsche Raster Gesellschaft has made screens of 18in. by 4½ft. in size, and has prepared positive reproductions in colour of corresponding dimensions.

The colours of the lines are so adjusted that the exposure is made without a yellow screen. It is also stated that screen bands of great length may be prepared from a cylindrical block, and may be used for cinematograph exposures in colours. The Neue Photographische Gesellschaft is also engaged on preparing a means of printing from these screen films on paper, and expects to prepare viewing screens on a celluloid support. The solution of this problem will perhaps involve greater difficulties than the preparation of a celluloid line-screen. It is to be hoped that the makers will succeed in producing screens of greater fineness, sufficiently fine, in fact, to allow of the production of the customary sizes of pictures, inasmuch as only a few amateur photographers are likely to make use of the process in the size of 7in. by 5in. and larger.

Dr. Stenger proceeds to quote again from "Photographische Industrie" as to the possibility of using the line-screen films for cinematograph purposes. He sees in the slight sensitiveness of the panchromatic emulsion an obstacle to such work, whilst another drawback lies in the very essential portion of the screen—namely, the linear ruling. Since, as at present made, the Krayn screen has seven lines per millimetre, the cinematograph positive must be enlarged at least 80 to 100 times—that is to say, each line will be 1-7mm. by 100mm. broad—*i.e.*, of 14mm. breadth—and therefore be plainly visible to the eye. If success is obtained in making a screen-film of 20 lines per millimetre, the projected image will then have its lines 5mm. broad. Such thin films of celluloid, however, would seem to be impracticable on technical grounds, whilst the degree of enlargement above specified would not be sufficient in very many cases, and therefore the conclusion would seem to be that cinematography in colours by this process leaves much still to be done before it is realised. It is also to be questioned whether the perforation of such thin bands of composite film will be strong enough to withstand the rough strain which it undergoes in the cinematograph projector, and a further question also arises in relation to the breadth and height which the screen-lines must have in order to avoid errors of parallax. Herr F. Faupel answers this question in saying that the thickness of the film should be at most one-half of the width of the line. If the film contains ten lines per millimetre it will be only .05mm. thick; if it contains twenty lines it will be .025mm. thick. It is doubtful whether such sections can be made in celluloid. A cinematograph film should be at least .1mm. thick, and if in such a film the lines had a breadth of only 1-20mm., there is bound to be very great error of parallax, owing to the lines being considerably thicker than their breadth. If a positive on an ordinary Krayn line-plate is held up, the clear sky in it appears actually blue, but if it is viewed sideways, from the right or left, the previously blue sky appears red or green, a fact which confirms the apprehensions of the above author. It is therefore necessary, concludes Dr. Stenger, that an open mind should be kept on the possibilities of the process, and that time should be given to see what the future will bring forth.

A further development of the Krayn system of colour photography is suggested by the following:—German patent (No. 193,463, of March 23, 1905), granted to the Deutsche Raster-Gesellschaft, for printing from line-screen negatives. The invention refers to a process for making colour-positives from negatives obtained behind a linear screen. If these negatives are viewed through the taking screen they will appear in the complementary colours to the original. If from them a copy is made with a line-screen interposed, a positive in the correct colours will be obtained. It is, however, necessary that each field or element of colour screen used for the copy should be equally distributed over the whole field of that picture, so that a coincidence of elements of the same colour should not preponderate. In order to fulfil this condition, although it is not possible to bring two line filters into coincidence, negatives prepared under line filters are used, a similar filter used, combined with the light-sensitive film, and the two placed in printing at right or acute angles. This enables enlargements of the colour negatives to be made. The line screens should be provided with a protective coating. This may be a collodion film or a thin sheet of celluloid. The patent claims a process for making photographs in natural colours by printing from a negative taken under a line screen and in combination with the same, the screen being used during printing, the lines of the linear colour screen crossing the lines of the negative during the printing at a right or acute angle.

THE "THAMES" SCREEN-PLATE PROCESS OF COLOUR PHOTOGRAPHY.

As announced in our advertisement pages this month, the screen-plate made under the patent of Mr. C. L. Finlay, published in our issue of September 27, 1907, is to become available to the public in a month's time. We can refer our readers to the above issue for details of the process by which the screen-plate is made; but we may say in brief that the figuration of the plate consists of two series of circles arranged symmetrically and each forming one-third the total area of the plate, the remaining interspace being, therefore, also one-third. We learn from Mr. Oliver Dawson, the agent for the new plates, that they will be issued with a panchromatic emulsion designed for the production of direct positives by a reversal process, such as is employed in the case of the Autochrome plate. As regards the fineness of the plates, the size of the circles is stated as 1-400th of an inch. The plates are to be marketed at the price of four quarter-plates for 2s. 6d., whilst a compensating filter for the lens will cost 5s. Orders for the plates are now being booked for execution in the sequence of receipt. We shall no doubt be able to give further particulars in the next issue of "Colour Photography" Supplement as the result of our own trials with the new introduction, which will no doubt further increase the great interest taken in screen-plate colour photography during the past six months.

Correspondence.

*** *We do not undertake responsibility for the opinions expressed by our correspondents.*

*** *Correspondents should never write on both sides of the paper. No notice is taken of communications unless the names and addresses of the writers are given.*

EXPOSURE IN AUTOCHROME WORK AND THE USE OF DIFFERENT COMPENSATION FILTERS.

To the Editors.

Gentlemen,—Among the various statements which have been made with regard to the uncertainty in exposure of the Autochrome plate, a consideration of one factor which appears to be at least a cause of the phenomenon appears to have been lost sight of. As Precht and Stenger have shown in their paper on "The Actinism of Colour in Daylight" ("B.J. Almanac," 1906, p. 868), the exposures through the three separate colour filters in ordinary three-colour work do not remain constant under all conditions of weather. It would certainly seem that under certain atmospheric conditions there is an excess of some of the constituents of white light. It is admitted that by illuminating the subject with coloured light of the proper spectral quality no screens are necessary, and it seems to follow that any colour in the atmosphere must affect the individual exposures. To sum up, the question does not appear to be one so much of incorrect exposures, but of colour screens rendered temporarily incorrect by colour in the atmosphere.

The same thing must apply in a composite three-colour filter, such as that of the Autochrome plate, and I put forward as a means of minimising the possible error the use of a set of three screens adjusted to suit different qualities of light, *e.g.*:—

1. Below par screen (for use with deficiency of violet rays in the light).
2. Standard screen (for use when light is well balanced).
3. Above par screen (for use when violet light is in excess).

It appears to me that a careful record, under all the varying conditions of light, of the actual time the paper in exposure meter takes to match standard tint should give some indication of the excess or otherwise of violet light, and to enable tables for use with the three screens to be prepared.

It would certainly add to the information on the subject if all users of screen plates kept a record of the time the meter paper takes to match standard tint, in addition to the usual particulars of time, date, light, etc.—Yours, etc., CHAS. LITCHFIELD.

Tetlow Bank, Cheetham Hall, Manchester.
February 16, 1908.

[The employment of an adjustable compensating filter for screen-plate work was adopted by the Macdonough-Joly Company in the brief semi-commercial exploitation of the process five years ago. We believe that while there is no scientific ground for the adoption of such means, the latter may be advisable in amateur or commercial work in order to make the best of unfavourable weather conditions. Whether the variations in the composition of the light are sufficient to account for the great variation in sensitiveness of the Autochrome plate (as measured by actinometer), further measurements would seem to be necessary before the fact can be considered established.—EDS. "B.J."]

New Apparatus, &c.

LENSES FOR COLOUR PHOTOGRAPHY.—Having received two Homocentric lenses from Messrs. Ross, Limited, 3, North Side, Clapham Common, S.W., with the request that we should report upon their suitability for three-colour photography with separate filters or with the "Autochrome" screen-plate, we were fortunate in hearing simultaneously of the method employed for this purpose at the L.C.C. School of Photo-engraving, Bolt Court, Fleet Street, E.C., a method which is sensitive enough for a test of this delicacy, and is nevertheless one which any photographer can carry out for himself. It consists in photographing a set of mono-chromatic filters, upon which a series of fine lines have been drawn—a line running without a break from one filter into another. Obviously any variation in the size or focus of the image through the different filters will be apparent when all three are photographed on a panchromatic plate. Tested under these conditions, the Homocentric of each series—$f/5.6$ and $f/6.3$—was found to exhibit not the slightest discernible deviation from equality of size and definition, and it was evident that their fitness for colour work was on a level with their good quality and repute in other respects.

◆

MR. COMLEY'S "ORANGES AND NUTS," a three-colour carbon print by the secretary of the Society of Colour Photographers, is reproduced—and very well reproduced—in last week's "Photographic News," from blocks made by the Regent Street Polytechnic Photographic School. Of the many examples of his three-colour work which Mr. Comley has shown at exhibitions, this picture has received more awards than any other. The reproduction is a wonderfully faithful copy of the original, and gives a very correct idea of the brilliancy and softness which Mr. Comley, almost alone among the workers we know, secures in his prints.

AN EXHIBITION OF AUTOCHROMES is to be held in Vienna, at the establishment of R. Lechner, the leading wholesale and retail dealers in the Austrian capital. Any of our Continental readers who can conveniently lend Herr Lechner examples of the Lumière process are asked to communicate with him at 30-31, Graben, Vienna.

THE AUTOCHROME IN ETHNOLOGICAL RESEARCH.—Some months ago we had the pleasure of conferring with Dr. Seligmann, immediately before his departure on an expedition among the native tribes of Kandy, Ceylon, and were able to recommend to him the most suitable equipment for the use of Autochrome plates among the picturesque up-country Singhalese. Hence we are gratified to read in a recent issue of the "Ceylon Observer" that a number of Dr. Seligmann's exposures have been satisfactorily developed by Mr. W. C. S. Ingles, of Colombo. Reference is made to the way in which the light complexion of the subjects comes out to the life, as do the big brown eyes and the dark hair. The dresses and the jewellery, the red coral necklaces, and some more ambitious ones set with different coloured stones are reproduced with astonishing faithfulness, and the whole photograph is extraordinarily life-like.

No. 16. Vol. II. APRIL 3, 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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MICROSCOPIC EXPERIMENTS ON SECTIONS OF THE AUTOCHROME PLATE.

(A Paper in "Photographische Rundschau.")

FIG. 1 shows a section of an Autochrome plate. A line-screen was illuminated by red light from a condenser and a copy of this screen made, same size, on an Autochrome plate. The time of exposure was adjusted from preliminary experiments, so that on development and intensification of the Autochrome plate the green and blue portions were rendered of full density whilst the red showed not the slightest trace of developed grain (silver deposit). It will be understood that in the portions corresponding to the black lines of the screen grains of every colour were represented by density, the red inclusive. The screen was divided into opaque and transparent bands of equal width.

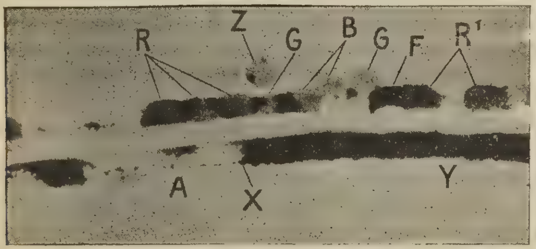


Fig. 1.

In the section, A is a portion of the developed film free from grain, and extends to X; the latter corresponds to three red grains R. Next these three grains comes a green grain G, then two blues, B, and again a green, G, after which are two other red grains, between which a gap is visible: a fragment of filling or a starch grain has fallen out of the film at this spot. The portion A corresponds with a transparent line-screen, that of Y with an opaque portion. X, however, is not necessarily a spot where an opaque line *touches* a transparent line. The exposure having been made by red light, the green and blue grains, equally in the exposed as in the unexposed portions, must be represented by dense developed grain (silver deposit). The black filling can be distinctly seen between the filter grains. Naturally, these differences can be seen much more plainly in the Autochrome plate than in the black-and-white reproduction, Fig. 1. A blue grain is to be seen at Z; it was cut out of another film and placed in position. The magnification of the photo-micrograph is about 500 diameters.

Parallax Errors in Screen-plates.

Between the film of starch grains and the developed emulsion of the film there is a certain interspace. This corresponds to the protecting film of varnish covering the layer of starch grains, and designed to prevent the solution of the colours in the different baths. The three films are of about equal thickness. A series of measurements have shown that the height of the starch grains in relation to their width is about as 2 to 3. It will be seen from Fig. 1 that, at a certain angle at which the Autochrome plate may be placed in relation to the line of sight, parallax and some degree of wrong colouring must result. The figure indicates that this phenomenon will occur at an angle of about 45 deg. The fact can easily be confirmed in the case of any Autochrome plate. If an Autochrome plate be held up to the clear sky, or still better, at night time, to an incandescent gas mantle, a characteristic change in the colouring will be noticed as the plate is tilted. At a certain angle, colours which were previously not highly luminous assume a characteristic matt appearance, though still preserving their correct colour. The red thus remains red, but the colour assumes a saddened appearance. If the Autochrome be strongly angled, it will appear almost like an ordinary monochrome transparency or negative. This can be plainly seen in the case of soft colours and Autochromes of slight density. The phenomenon can be ascribed to the fact that at a certain angle the observer misses, through the clear spaces in the developed film, those grains which, lying perpendicularly under the clear spaces, produce the coloured image when correctly viewed.

As the grain of the Autochrome plate is irregular, no actual reversal of colour can take place, but the general tendency is towards the dilution of the colour with white when viewed at an angle. The arrangement of the grains being, as has just been said, irregular, it is just as probable that light falling through any clear space at an angle will fall upon a red grain as upon a blue or green. It follows from this that reversal of colour cannot take place in an Autochrome plate as it can with other screen-plates ruled in regular geometrical fashion. The retention of the characteristic colours in the plate when viewed angularly depends upon the fact that part of the light is irregularly diffused in the film. Notwithstanding that the dimensions of the Autochrome starch-grain units favour changes of colour due to parallax, a change also favoured by the distance of the developed film from that of the starch grains, yet in point of fact wrong colouring at angular observation is rarely observed in the case of Autochrome plates. The reason for this is that the Autochrome has an irregular-surfaced grain. A plate of regular formation—that is to say, composed of lines of definite series—would have to have quite different ratio of height to width in order to permit of it being viewed at the same oblique angle as can the Autochrome plate. Those who have seen transparencies on a screen-plate of regular formation will have noticed that a relatively slight change in the angle at which the plate is viewed produces distinct changes in the colour. Red may thus become green when viewed from one side and blue when viewed from the other. The axis of rotation of the angular movement must be parallel with the lines of the screen. If perpendicular thereto, no miscoloration can be observed. By means of bichromated colloid printing methods, it is doubtless easily possible to prepare regular screen-plates, the height and breadth of the lines in which are such in relation to each other that the parallax errors above mentioned are not introduced.

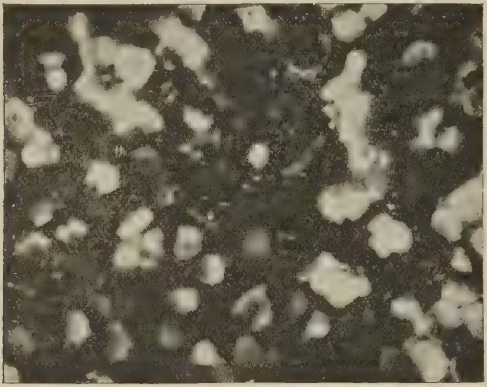


Fig. 2.

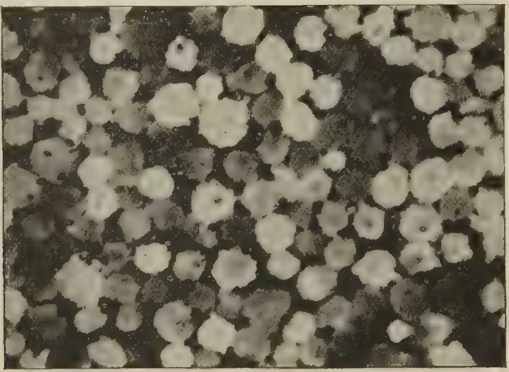


Fig. 3.

Copying one Autochrome from Another.

Much has been said of late as to whether one Autochrome can be reproduced from another Autochrome or not. Experiments have shown that this is possible. Fig. 2 is a photo-micrographic print of two Autochrome films pressed one on the other. It will be clearly seen that great loss of light is the result. Wherever unlike colours overlap no light is transmitted. On making a number of such exposures, it will be found that the assumptions of Dr. Kenneth Mees are fully confirmed. If, however, there is a space between the two screen-plates, the appearance of the photo-micrograph taken on the upper plate is then as shown in Fig. 3. The lower starch grains are in this case formed on the upper film as discs of confusion by means of the scattered light. And if this disc of confusion is large enough, every such disc representing, for example, a red grain, will cover several red grains, and blue, green and other grains will thus be made by red light. The diffusion image

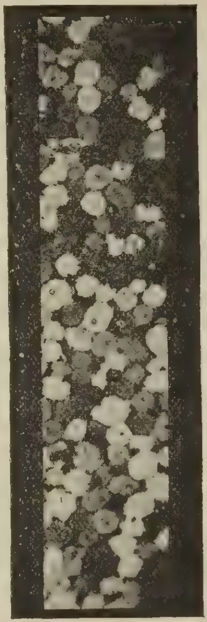


Fig. 4.

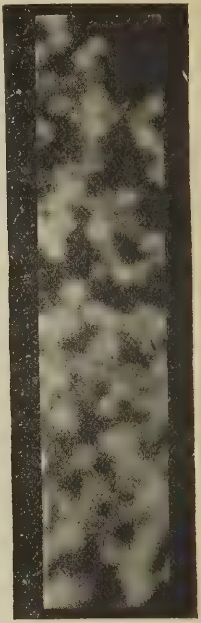


Fig. 5.

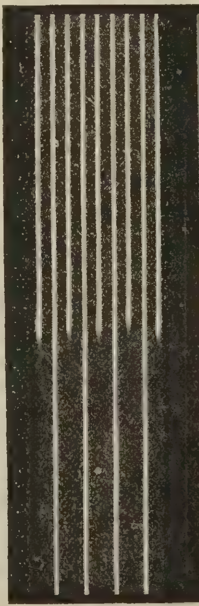


Fig. 6.

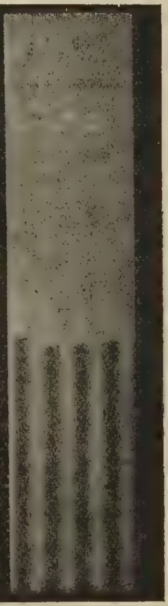


Fig. 7.

of an Autochrome screen will appear white, and the microphotograph in the second case must appear exactly as if it were a screen illuminated only with white light. Fig. 4 shows the developed film of the red exposure of the line screen mentioned above viewed by reflected light. The clear spaces correspond to red filter grains. If an attempt is made to form very small transparent dots with a photographic lens it will be noticed that the image of this small object is a tiny disc. This tiny disc consists of concentric rings lying close to each other. The phenomenon can be easily observed if a highly polished sphere is allowed to lie in the sun and its image examined on the focussing screen with a good magnifying lens. In making this experiment the ground glass must be replaced by a piece of clear glass. Just as in the case of the image of an artificial star (a small image of the sun on the sphere), the images of the separate starch grains and clear spaces in the developed film of the Autochrome appear when formed by a photographic lens when reproducing one Autochrome from another in the solar camera. However, the unsharpness thus caused is so trifling that it can be dismissed as negligible. It should therefore be clearly stated that only in consequence of this phenomenon is the reproduction of one Autochrome from another possible.

Figs. 4 and 5 supply an explanation of these phenomena. Fig. 4 is a photo-micrographic reproduction of an Autochrome plate with microscopic lens of sufficiently large aperture. Fig. 5 is a similar result made of the same area of the plate with the same focus and the same lens. It differs only in that the stop in the microscope has been slightly reduced. It can be plainly seen that instead of the sharp image of the screen a diffused image is produced which bears scarcely any resemblance to the true form of the grains.

The same thing can be seen even plainer still in Figs. 6 and 7. Fig. 6 is a reproduction of a series of lines (Abbé diffraction plate) taken with aperture of sufficient size, whilst Fig. 7 is the same thing, but with too small an aperture. It will be plainly seen that, instead of the sharp reproduction of the lines, an almost evenly diffused surface is the result. If we assume that in the nine lines the sequence of colours is regular —that is to say, red, green, and blue—then with sufficient stopping down of the brilliancy the area shown in Fig. 7 will be approximately white.

Dr. W. Scheffer.

AN EXPOSURE METER FOR AUTOCHROMES.

[The following suggestion in the "Photo-Revue" for an exposure-meter for Autochrome plates is based on a visual photometric observation of the object by means of a small and portable photometer.—Eds. "B.J."]

All those who have used the Autochrome plates are aware of the importance — and the difficulty — of ascertaining the correct exposure. As the result of many failures, I have been led to construct a meter which, though not yet perfect, has nevertheless been very valuable to me. In describing it, my hope is that some other amateur may be able to improve it further.

The Theory of the Instrument.

When developing, reversing, and intensifying an Autochrome, a necessary condition of correct reproduction is that each filter unit transmits the same proportion of monochromic light as was received during exposure. If we take as equal the three luminous intensities, red, green, and blue violet, which give us white, it will be sufficient that the transparency of the silver deposit reduced through each screen shall be proportional to the quantity of light transmitted to the emulsion through the same screen during the exposure.

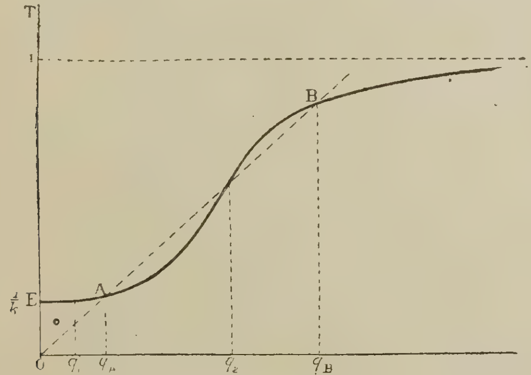


Fig. 1.

From the nature of an emulsion, the transparency curve of a plate exposed to varying intensities is of the type shown in Fig. 1. Theoretically, the transparencies through the red, green, and blue filters should lie on the dotted straight line; practically, it will suffice if they lie on the portion of the transparency curve between A and B.

The Principle of the Meter.

From what has been said, it will be understood that to measure the exposure required for a given subject, it suffices to measure maximum monochromatic luminous intensity of the brightest part of the subject. In giving a time of exposure such that for this monochromic colour the value qB is not exceeded, the part corresponding with the subject will be rendered as a light tint, but not, however, clear glass. The darker parts of the subject will come just within the lower limit qA, corresponding in practice with about 1-6th of qB. In making these measurements it is necessary, theoretically, to compare the subject through the three screens, red, green, and blue-violet. In practice, the orange or red screen answers quite well. In the case of portraits, the face is the part chosen for adjustment; in landscape, the greens or yellows in the best lighted part of the subject.

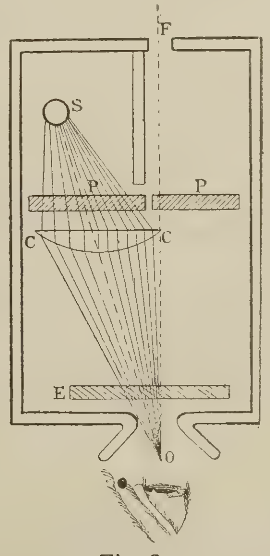


Fig. 2.

Construction of the Meter.

The standard consists of a small paraffin lamp, the frame, S, of which can be adjusted to a constant height. A condenser (Fig. 2) cc^1, the vertical edge c^1 of which is rectilinear, throws an image of the homogeneous parts of the frame which is formed at o on the pupil of the observer. This image should be larger than the pupil, and be at least 6 mm. in diameter. In these circumstances, the condenser has the appearance of a bright uniformly lighted surface, and it is juxtaposed against the subject which is viewed directly by the eye through the aperture, F. The apparent brightness of the subject and of the condenser varies in equal ratio as the pupil contracts. The orange screen is placed at E against the eye-hole.

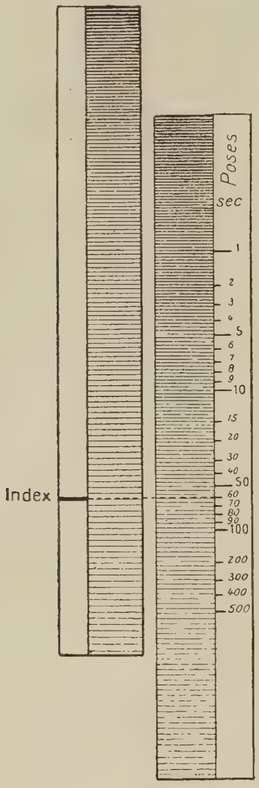


Fig. 3.

In order to measure the brightness of the subject, the latter has to be brought to the same brightness as that of the condenser. For this purpose, two identical tinted wedges, P and P1, are used. These wedges can be made of two prisms of smoked glass, or can be prepared by exposing a thickly coated slow plate with a shutter in front slowly rising with a uniform motion.

After development the transparencies will be roughly proportional to their distance along the wedge, and two or three graduated slips may be cemented together for use. The wedges may be calibrated by exposing a piece of bromide paper under one of the wedges for relative times of exposure of 1, 10, and 1,000. It only remains then to ascertain the concordance of the gradation of the wedge P and the index attached to the wedge P (Fig. 3). This is done by exposing an Autochrome plate in strips with increasing exposures, in order to find the exact exposure, which is afterwards marked on the meter, after having obtained equal tints by moving the wedges.

The above is, in brief, the principle of the apparatus. The latter is susceptible of improvement, but, such as it is, it has already been very useful to me. In outdoor work I have exposed without a single failure from midday sun to dusk, the exposures varying from 2 seconds to 5 minutes. For interiors and under trees, the apparatus has uniformly given exposures under the correct. This can scarcely be due to errors in taking the readings, since check readings were taken with proper precautions; on the other hand, seeing that a panchromatic plate and compensating filter are used, it can hardly be a question of different actionism. Thus I stop by confessing a difficulty which perhaps some of my readers can assist me to overcome.

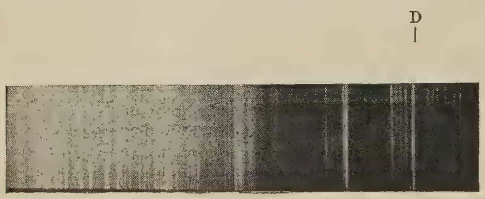
A. Peaucellier.

Note.—This difficulty is apparently identical with that already noted by Mr. Watkins and other English workers, and may be ascribed to an unusually large failure of the Bunsen Roscoe law with the Autochrome plate.—Eds. "Colour Photography" Supplement.

A GREEN-LIGHT CARBON.

In the "B.J." for October 12, 1906, p. 846, there appears a brief note, an abstract from Eder's "Jahrbuch," in which Mr. Wm. Gamble deals with the illumination of an original by coloured light, and, *inter alia*, says: "So far he has not been able to obtain green illumination, though there should be no difficulty in this, considering the number of chemicals which give green lights." This set me thinking and working, with the result that I have arrived at a very successful green-light carbon.

For other purposes I wanted to obtain spectra of all the principal carbons obtainable commercially, and by the kindness of Messrs. Penrose I was able to test their yellow and red flame carbons, with excellent results. They also sent me a white or very pure carbon, which is specially intended for use with the violet-blue filter for three-colour work. Experiments were made with various salts, such as the nitrates of cobalt nickel, copper, and silver, and the carbons boiled in the same for an hour or so till thoroughly impregnated, which was rendered all the more easy in that these carbons have a soft core. Certainly the spectra obtained were richer in green rays, but the light could not be said to be green. It occurred to me that by using a wire core, composed of silver and copper, one ought to obtain the desired result.



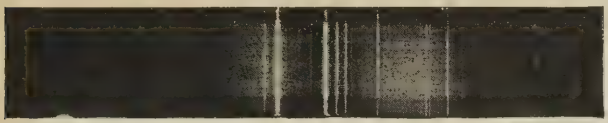
A

After some little trouble I was able to obtain two ounces of wire, composed of silver and copper (in the proportion of their molecular weights), and 2 mm. diameter. The soft core of the carbons was drilled out with a fine drill, leaving a hole of 4 mm. diameter. The wire was doubled and passed up the hole and the carbons placed in a lamp, fed with continuous current. The result was all that could be desired; there was at once a brilliant green light, which, however, instantly disappeared.

An examination of the arc showed that the wire core had disappeared, so the current was switched off and the carbon removed and examined, when it was found that the wire had fused and run down to the bottom of the hole. Little bits of the wire were then cut off and filled into the hole, the carbon replaced, and the arc formed. By switching the current on and off I finally succeeded in filling up the hole completely. The result is a brilliant green light of blinding intensity, which ought to be useful for three-colour workers.

The illustrations herewith show very distinctly why the light is so brilliantly green. In A we have merely the pure carbon, and it will be seen that although there are several lines throughout the green, yet they are none of them of great intensity.

B



B. Silver Copper Arc.

In B is shown the copper and silver carbon, and the intensity of the lines due to these metals can be fairly well judged by their intensity and breadth. The same make of plate, the same exposure, and slit width were used in each case. The difference between the two is very marked, and it will be noted in B that, although no green filter was used, the characteristic lines in the violet are wanting.

Whether it would pay to put such carbons on the market must be left to those who are interested in such things commercially. The cost of the wire in quantity cannot be great, considering the present price of silver: naturally, as is always the case when one wants special things for experiments, I had to pay somewhat heavily for it.

The silver lines are 5471, 5465, 5209, 4668, 4476, the remainder being due to copper; the most intense of the latter is 5218.

E. J. Wall, F.R.P.S.

ALCOHOL AS AN AFTER-BATH IN COLOUR-SENSITISING DRY PLATES.

[The following paper by Herr Paul Thieme in "Photographische Mitteilungen" describes a variation of the procedure recently recommended by Valenta for the rapid bath-sensitising of gelatine plates.—Eds. "B.J."]

In regard to the addition of alcohol to a dye bath which has been recently suggested for the sensitising of dry plates, the denatured spirit should be serviceable for that purpose, the addition giving quicker drying and cleaner results. It has further been suggested that rinsing of the plates as they come from the dye bath is not necessary. It has, however, been my experience that by omitting the rinsing of the plates drops form on the latter, and on drying give rise to a greater degree of dyeing and to spots. If, however, the plates are rinsed, it is not possible to use the denatured spirit, as the film does not then "take" the water uniformly, and spots and streaks occur even more rapidly than when the plates are not rinsed. A longer washing after the dye bath is an improvement, but the plates then take up so much water that the drying requires almost as long as it does after a dye bath containing no spirit. I found that a very advisable course is to rinse the plates with alcohol after the dye bath. The alcohol removes the water from the surface of the gelatine, and clears the latter of dye, as the colouring matter is much more soluble in alcohol than in water. As a result, the surface of the film is very free from dye, also particles of dust are swept off if, during rinsing, the plates are held with the film downwards. Drying takes place very quickly; so quickly, in fact, that the alcohol can be dispensed with in the sensitising bath.

Previously I was accustomed to dry plates in a cupboard with an electrical ventilator, placing chloride of calcium in a dish. Now I simply use large plate boxes containing a few pieces of chloride of calcium. The boxes are placed in a cupboard standing in a warmed room. Plates bathed for two or three minutes in a bath containing no alcohol, and rinsed in alcohol, will dry in about an hour and a half. The calcium chloride should not be put direct in the boxes, otherwise the material of the latter will absorb any resulting solution of the chloride and will then never dry.

Long and Short Drying for Sensitised Plates.

For many dye stuffs a period of drying for one and a half hours is too short. Thus the red-sensitiser "Wollschwarz," recommended by Eder, requires that the plates remain moist for six to eight hours, in order to get good sensitiveness. Most sensitising dyes, such as accridine, erythrosine, and cyanin, appear to combine so quickly with the silver bromide that qucker drying does not in any way weaken their action. I, however, tried to remove the water from plates sensitised in a quite aqueous bath by giving them five minutes' immersion in alcohol. Comparative exposures of plates which had received two minutes in the dye bath were made. One half of the plate was then rinsed in alcohol, whilst the other had the water completely removed from it. Both halves were exposed together, when it was found that, in the case of the plate which had had its water completely removed by alcohol and had dried very quickly, a distinctly lesser action of the dye was observed. If this plate, however, was given fifteen minutes in the dye bath and was then compared with the plate which had been immersed two minutes only and then rinsed in alcohol, no difference was noticeable, except that the first plate (completely deprived of water) was a little longer in developing.

The Superficial Action of Alcoholic Baths.

These experiments should go to prove whether the alcohol bath may be used to remove the dye from the silver bromide. According to previous experiments, it cannot be expected to. The experiments of Dr. Traube on the drying of silver iodide, according to which the iodide cannot be decolourised without decomposition, render it improbable. The slight colour-sensitiveness of the half of the plate deprived of water in the experiment above described must be due either to the fact that the combination of the dye stuff and the silver bromide requires more than two minutes, or that the dye stuff has not sufficiently penetrated into the film in this time. A plate was therefore bathed for two minutes in erythrosine solution and observed in daylight. The film side appeared dyed, but no trace of colour was to be seen from the glass side. Longer bathing gave rise to dyeing visible from the glass side, but that on the film side was stronger. After drying in the air the dyeing was almost even. Quicker drying by means of alcohol was thus seen to prevent the sensitising of the deeper portions of the silver bromide of the film. After a more prolonged immersion in the dye bath, the action of the latter had penetrated deep enough, but the upper portion of the film had taken up too much dye, and had given rise to screen action. Finally, in a further experiment, one half of the plate was rinsed in alcohol, the other allowed to remain thirty minutes and then deprived of its water. No difference was discoverable between the two halves af the plate treated in these two ways.

It is thus clear that drying in alcohol immediately after the dye bath is to be strongly avoided, both on account of the slight sensitising of the lower parts of the film and of the excessive dyeing of the upper parts.

Bathe in Water Dye-baths: Rinse in Spirit.

The above experiments had chiefly for their object the drying action of alcohol. The influence of the latter on screen action has been only casually referred to. This latter is, however, by no means negligible in the case of dyes which have great tendency to dye gelatine. In dye baths made up with alcohol the gelatine, in a bath of equal concentration and used for the same length of time, will dye much less than in baths free from alcohol. If we rinse the plates dried in alcohol the gelatine is deprived of a notable quantity of the dye, and the screen action is thus lessened. This removal of the dye by alcohol has been experienced by me in the case of accridine orange N O, a green sensitiser which does not tend so strongly to yellow as does erythrosine.

It should also be mentioned that addition of ammonia to the dye bath also produces a slighter dyeing of the gelatine. This is particularly noticeable in the case of ervthrosine. Accridine orange N O should not, however, have ammonia added to it, as in a watery solution ammonia gives a turbidity and a yellow precipitate. With thirty per cent. alcohol, however, a fair amount of ammonia can be added without producing a precipitate, the colour passing from reddish to bright yellow and the sensitiveness being shifted a little towards the blue-green.

The conclusions from the above experiments are:—(1) The use of aqueous sensitising dye baths followed by rinsing in denatured spirit, this latter being done in two stages, the first for the removal of the bulk of the dye and the second for the removal of drops of dye solution; (2) for specially quick drying the use of an aqueous dye bath, on emergence from which the plates are allowed to lie in a moist state for thirty minutes, are then bathed in spirit for five to six minutes, and then rinsed in a second spirit bath.

PAUL THIEME.

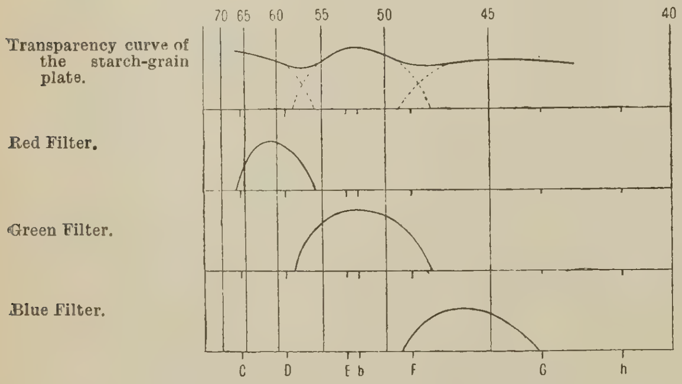
AUTOCHROME ITEMS AND ACCESSORIES.

Baron Von Hubl on the Sensitiveness of the Autochrome Plate.

Baron von Hübl states in the "Wiener Mitteilungen" that if an Autochrome plate be treated with alcohol the varnish over the starch grains will dissolve. The dyes are insoluble in alcohol, ether, and benzole, but the red and green are soluble in water, the blue being apparently insoluble. If the plate, after removal of the varnish, be treated with benzole the starch grains are set free, a fact which points to rubber being used to make them adhere to the glass. The grains are so deeply stained that when placed on white paper they look black.

The author has measured the transparency of the grains with a spectrophotometer, and gives the following table and curves from the same:—

For λ 707	the transparency is	0.15
,, λ 652	,, ,, ,, ...	0.15
,, λ 572	,, ,, ,, ...	0.09
,, λ 518	,, ,, ,, ...	0.16
,, λ 488	,, ,, ,, ...	0.11
,, λ 455	,, ,, ,, ...	0.11
,, λ 420	,, ,, ,, ...	0.10



As will be seen from the curve, the light passing through the plate contains too little blue-green and orange, but as these are complementary colours, their subtraction from white light does not give colour, but lower luminosity.

By an artificial light—that is, one poor in blue—all Autochromes appear reddish. It is advisable, therefore, to place a pale blue-green glass between the light source and the Autochrome.

The transparency curve of these plates, as shown by the dotted lines in the above figure, can be divided into three parts, which are the "openings" or transmissions of the filters. They actually transmit only narrow portions of the spectrum; the action of the red filter is limited (by the sensitiveness of the plate) to C, the yellow screen absorbs all rays beyond G, and "dampens" those between F and G. They are therefore narrow filters, and their transparency curves have nothing to do with the fundamental colour-sensation curves of the Young-Helmholtz theory. They differ considerably from those curves deduced from other theories, according to which overlapping is essential. Autochrome plates teach us, therefore, that these views are not correct, and the shading off of their transmissions is due to the non-existence of sharp-cut dye absorptions. The filters are in complete accord with the view that all colours can be made from three spectrum colours. Based on the theories of the Autochrome plates, we ought to use, for all methods of colour-photography, narrow, intense-coloured filters, so chosen as regards the colour-sensitiveness of the plates as to produce density curves like the above transparency curves.

Mosaic or Line Screen-Plates from Three-Colour Negatives.

THE introduction, either actual or promised, of mosaic and line screen-plates, whilst placing a still greater power in the hands of the colour worker, will probably considerably curtail the use of the older processes, in which three separate pictures have been used. There are, of course, many workers who have a collection of three-colour negatives, and doubtless many will therefore welcome the method suggested by Dr. E. Stenger in "Das Atelier des Photographen" for obtaining pictures on Autochrome or other screen-plates from the same. It has been pointed out that it is possible to obtain the three constituent negatives or positives from linear plates, but Dr. Stenger now suggests the reverse operation.

The first essential is to provide the negatives with register marks, the method recommended being that given by H. Cl. Klosel for multiple-gum prints. Round each negative is fastened a frame of thin card, a few centimetres larger all round than the negative, and the printing paper is fastened to the card frame by drawing-pins. With large negatives two strips of card on opposite sides of the negative may be used. A sheet of P.O.P. or collodio-chloride paper is now printed under one of the negatives. The paper must be large enough to completely cover negative and frame and should be fastened to the card frame with drawing-pins. The print is now waxed or oiled, so as to make it as translucent as possible. A thin paper, without a baryta support, is there advisable. The print is now placed on a retouching desk, and the other two negatives brought into absolute register with it. The holes made by the drawing-pins in the print edge are now pierced through with a fine needle into the card frame. If this is accurately done the negatives will at once fall into register when these holes are superimposed. A transparency may be used instead of a print if desired. The Autochrome or screen-plate must also be provided with a card frame.

The superposition in accurate register for printing is easily effected. One of the negatives is laid in a printing-frame, which must be larger than the actual negatives and provided with a sheet of plate glass. Through the register holes in the card frame surrounding this negative should be thrust three strong drawing-pins, their points being towards the back of the frame. On this negative is laid the screen-plate with its card frame, next a sheet of thick felt, and finally the printing-frame back. By closing the latter the points of the drawing-pins are driven through the card surrounding the screen-plate, and through the felt into the back. In printing from the other two negatives, which must also be provided with drawing-pins, care must be taken that the pins pass through the holes in the card frame of the screen-plate's card frame, which holes were made by the pins of the first negative. Even in the dark this is not a difficult matter.

Printing must, of course, be done through the filter elements of the screen-plate. From the three negatives a colour-correct positive will be obtained, and from three positives a negative in complementary colours, which can be reversed like an Autochrome plate exposed in the ordinary way.

Correct exposure is of great importance. This depends on the spectral composition of the light used on the three-colour filters, placed between the light source and printing-frame, and on the more or less correct exposure of the constituent negatives. An electric incandescent lamp should be used at a fixed distance. From actual experiments it was found that with a 100 c.p. electric lamp at 100 cm. distance the exposures were as follows: Ratio of exposures for the three-colour filters for daylight, $1:1\frac{1}{4}:4\frac{1}{2}$; ratio for electric light, $1:\frac{1}{3}:\frac{1}{3}$ for the blue, green, and orange respectively.

Using an Autochrome plate, the ratio of exposures was $1\frac{1}{2}:4:1$; and the actual exposures 90 : 240 : 60 seconds for the blue, green, and red. The time of development was 150 seconds, the developer being rodinal 1 : 20 at 61 deg. Fahr. With the Krayn linear-plate the ratios were $41:3\frac{3}{4}:1$, the actual times of exposure 330 : 30 : 8, and duration of development 135 seconds. The Autochrome plate is best suited for transparencies of the same size, and the Krayn plate, on account of its coarse rulings, for enlargements.

EXPERIMENTS ON THE SENSITISING POWER OF SOME NEW DYES.

The following is a tabular statement of the latest experiments made by Professor Valenta, of the well-known Institute of Graphic Arts, Vienna, on some hitherto untried dyes. The method of use was the same as previously described in the papers by the well-known experimenter. The German names of the dyes are given, and the makers contracted thus:—By = Farbwerke, vormals Bayer & Co.; M.L.B. = Meister Lucius and Brüning, Hoeschst; B.A.S.F. = Badische Anilin u. Soda Fabrik.

Dye.	Maker	Region Sensitised.	Remarks.
Chromschwarz F and B.	M.L.B.	C—D$\frac{1}{5}$ E	Faint maximum D$\frac{1}{3}$ C.
Alkali-echtgrün 3 B	By	E—B	Narrow band at A. Water soluble, absorbs red, orange, yellow.
Diazo-Brillantscharlach	By	C—D	Only visible with long exposure.
Dianil-Eshtscharlach 8 B.J.	M.L.B.	Max. D$\frac{2}{3}$ C	Gives a narrow band only with long exposure.
Walkblau 2 R extra	M.L.B.	D$\frac{3}{4}$ C—beyond B.	Not a vigorous sensitiser.
Typophorblau	B.A.S.F.	Max. at C	Very weak sensitiser.
Typophor AR	B A.S.F.	D—B	Strong but narrow band, max. D$\frac{1}{2}$ C.
Baumwollscharlach extra	B.A.S.F.	Max. C.	Weak sensitiser.
Oxaminkupferblau RR	B.A.S.F.	Broad band, Max. D$\frac{3}{4}$ C.	Medium sensitiser.
Säureviolet P.W	B.A.S.F.	Band between C—D	Weak sensitiser.
Typophorviolett	B.A.S.F.	E$\frac{1}{2}$D—C	Max. D $\frac{3}{4}$ C. Weak sensitiser.
Astazinrot B	B.A.S.F.	Narrow band D—C	Medium sensitiser.
Lichtgrün SL	B.A.S.F.	Narrow band Max. D$\frac{1}{2}$C	Weak sensitiser.
Echtsäuregrün BB	M L.B.	Weak band C—B	Weak sensitlser.
Rhodaminponceau G extra	M.L.B.	Weak band C—B	Weak sensitiser.
Säurechromschwarz RH	By	Two bands D$\frac{1}{4}$C—D$\frac{3}{4}$C Max. D$\frac{1}{2}$C., C—C$\frac{1}{2}$B	Medium sensitiser.
Naphthylaminschwarz, 10 BN, 6 BN, 4 BN	By	—	Even action, only with long exposure, to beyond C.

Dye.	Maker	Region Sensitised.	Remarks.
Patentdianilschwarz E and EF conc.	M.L.B.	Before D—A (almost)	Strong broad band with medium exposure. Max. D $\frac{3}{4}$ E with long exposure. EB most active.
Thiogendunkelrot G	M.L.B.	—	Even sensitiveness with long exposure to beyond B.
Diamantblauschwarz	By	D$\frac{3}{4}$—C	With long exposure extends to A. Max. B $\frac{1}{2}$ C.
Brillantreinblau G, 5 G	By	D$\frac{3}{4}$—C	Weak sensitiser.
Kaschmirgrün B	By	between C—D	Weak sensitiser.
Echtlichtgelb 3 B	By	Max. D$\frac{1}{2}$C	Weak sensitiser.
Helioechtblau BL conc.	By	—	With long exposure two bands, oue weak with max. D $\frac{1}{3}$ C, the other strong, max. C $\frac{1}{2}$ B.
Helioechtblau SL conc.	By	—	Acts more strongly than BL. Shows only first band.
Helioechtviolett AL	By	D—C	—
Brillantheliopurpurin B	By	D—E; also Max. D$\frac{1}{3}$C	Weak sensitiser.
Alizarin Emeraldol G	By	A—a	Strorg sensitiser. With long exposure a second narrow band with max. D $\frac{1}{3}$ C shows.
S. Alizarin-Blauschwarz 3 B	M.L.B.	C—C$\frac{1}{4}$D with short exposure.	With prolonged exposure extends to A.
Azos-Rot 6 B	M.L.B.	D—E	With longer exposure another band between C-D, with max. at C.
Auroflavin K R	M.L.B.	—	A yellow dye, sol. in water. Sensitises strongly for green. Max. at E. With medium exposure action is continuous from D$\frac{1}{4}$ E to ultra-violet. Can be used for collodion emulsion.

The following dyes are very weak sensitisers, or do not sensitise at all:—Algolblau CF, EG (By); Algolbraun B (By); Algolgrün B (By); Alizaringelb 5 G, KR (M.L.B.); Alizorin-Rubinol R (By); Brillant-Alkaliblau (B.A.S.F.); Astazinrot G extra (B.A.S.F.); Brillantkarmin L (B.A.S.F.); Brillantechtblau B (By); Carbonschwarz GAT (M L.B); Chromogleucin BMG (M.L.B.); Chromotrop DW

(M.L.B.); Diamantblauschwarz R (M.L.B.); Dianilchrombraun G and R (M.L B): Dianilectscharlach 8 BJ (M.L.B.); Diazobrillantorange (By); Indanthren S (B.A.S.F.); Katigenindigo G extra (By); Katigenviolett B (B.A.S.F.); Lackbordeaux B (M.L.B.); Ledergeltbase 3 BO, OB (M.L.B.); Oxaminblau GN (B.A.S.F.); Philochromine B, G (M.L.B.); Säurechromblau B (By); Thiogenblau BD conc., R, RR (M.L.B); Thiogenbraun RR, SD conc. (M.L.B.); Thiogencyanin O, G (M.L B.); Thiogendunkelrot R (M.L.B.); Thiogengrün B, GG, GL, GLD conc., RL (M.L.B.); Thiogenheliotrop O (M.L.B.); Thiogenkatechin R (M.L.B.); Thiogenmarineblau R conc. (M.L.B.); Thiogenpurpur O, OD extra stark (M.L.B.); Thiogenschwarz BB,BR, M. (M.L.B.).

New Books.

"Die Theorie und Praxis der Farbenphotographie mit Autochromplatten." By Baron A. von Hübl. (Halle: W. Knapp, M. 2.)

This monograph on the Autochrome plate does not contain much that has not already been said, but it contains an exposition of the screen-plate colour process which has all the qualities of lucidity by which Baron von Hübl's writings are marked. The first couple of chapters are taken up by a discussion of the principle of additional processes of colour photography in this particular application, and we then get a description of the manufacture of the Lumière plate, which the author positively designates as bearing a gelatine emulsion.

In the part of the book dealing with the practice of the process we find nothing that has not been recommended, except perhaps the advice to soak Autochromes intended for projection in a 5 per cent. solution of glycerine; their retention of a little glycerine will then keep them from becoming so dry as to crack. Practical workers here, however, have not found this method advisable.

The volume confines itself strictly to the Autochrome plate, and has not a word to say on other proposals for producing a screen-plate. Of some of these it would have been interesting to have heard Von Hübl's opinion, and it is to be hoped a further monograph by him will complete his treatment of the screen-plate method in colour photography.

Correspondence.

⁂ *We do not undertake responsibility for the opinions expressed by our correspondents.*

⁂ *Correspondents should never write on both sides of the paper. No notice is taken of communications unless the names and addresses of the writers are given.*

ACID AMIDOL FOR THE DEVELOPMENT OF AUTOCHROMES.

To the Editors.

Gentlemen,—Re the article by Charles Simmen, "Colour Photography" Supplement of February 7, on the acid-bisulphite method of developing Autochromes by orange light, after preliminary soaking in 10 per cent. solution of sodium bisulphite, I find that (after a number of experiments) there is a loss of brilliancy after the picture is finished. Intensification, it seems, is unnecessary, as an exceedingly dense result can be got by prolonged development. A larger percentage of amidol cuts the exposure down (an abnormally long exposure is required by this method), and even a longer development, and an increase of potass and bromide fails to give the brilliancy obtainable by the old method. By the above method the plates need not be waxed, as frilling is almost impossible, unless handled carelessly, and, but for lack of brilliancy and long exposure, seems an ideal way of producing Autochromes with comfort. Possibly the author of the new system will publish the results of later research and experiments, which will be awaited with interest by yours, etc.,

21, Grantham Street, Lincoln. **Charles A. Dowier.**
March 21, 1908.

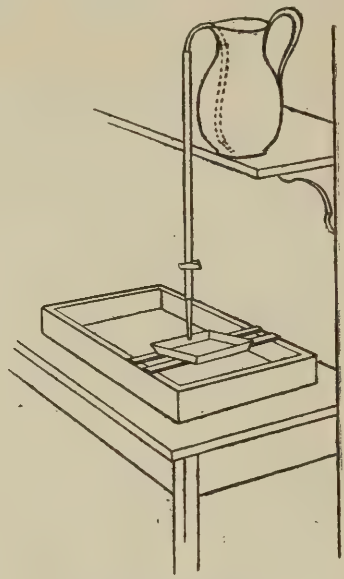
WASHING AUTOCHROME PLATES.

To the Editors.

Gentlemen,—In the matter of the washing of the Autochrome plate, I think the simple device which I have adopted may be a useful hint to others. I use a large enamelled iron jug of about half gallon capacity, which is an ample supply per plate for all washing, even if the whole of the Lumière procedure is carried out as per their instructions.

With about 1½ yards of indiarubber tubing and three small glass tubes (all of the size used in the fitting up of feeding bottles, and obtainable at the chemist's), and a small wooden clip, the whole outfit is complete.

One tube is for sinking the indiarubber tubing to the bottom of the jug. The second, carefully warmed up in a gas flame, can be bent into a U-shaped piece for carrying the flow from the half yard of rubber in the jug to the one yard used as the hanging portion of the syphon. Tube No. 3 at the outlet keeps the lower tube hanging perpendicularly, whilst the wooden clip serves as a check upon supply of water.



I have used such an apparatus ever since I took up Autochrome work—never remove the plate from the original dish in which it is developed until ready for drying—and have never had a frill (a thermometer to correct the temperature of washing water is a necessity, of course), and I find that washing in this manner is far more satisfactory than a tap in every respect. Hoping this may help other workers.—Yours faithfully, **Hugh Edgson.**

27, Union Street, Ryde, I.W.
March 20, 1908.

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The Autochrome Process.—E. Shivas writes: "In the course of my experimenting with the Lumière Autochrome plate I have had occasion to take several portraits of sitters in black clothes, and invariably I have found that these black clothes come out blue in the finished picture. The blue is noticeable at once on reversal, and does not alter in subsequent operations. You will probably suggest under-exposure as being the cause, but I find on increasing the exposure that the blue still persists, even though exposure is increased to the extent of dulling the flesh tints through over-exposure. This blue colour is only on the clothes, and does not extend to the other parts of the picture. I find that the only way to render black clothes with anything like true black is to under-expose greatly, so that black is caused by the total want of light action, and the subsequent blackening of the unexposed part with the amidol developer. But, of course, the picture is not good—it is so dense and lacking in brilliancy. Is this defect caused by the lack of latitude in the Lumière plate? It is possible that the black clothes would come right with a greatly increased exposure, but then the brilliancy of the flesh tints would go. Strange to say, the shadows of a deep red object give a satisfactory black, but where black clothing is facing the source of light, the colouring is invariably blue.

[We have seen black clothes excellently reproduced in Autochromes. Probably your difficulty is due in some measure to the character of the light at this time of year. On the other hand, it must not be forgotten that many so-called blacks are really blue blacks, possibly sufficiently blue for the colour to be recorded by the Autochrome when photographed in a strong light. We believe that other workers who have been troubled by a prevailing blue tint have found a very light yellow screen beneficial.—Eds., Colour Photography Supplement.]

No. 17. Vol. II. May 1, 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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MONSIEUR MEYS' AUTOCHROME PICTURES.

When I was examining some of the Autochromes at the R.P.S. last year I was asked by a well-known photographic scientist whether I did not think that the technician would produce better Autochromes than the pictorialist. My reply was that to avoid the distressing juxtaposition of conflicting colours, such as was visible in some of the exhibits, the artist's selection was even more necessary than it was in monochrome work.

The truth of what I advanced was fully brought home to me when witnessing Monsieur Meys' magnificent Autochrome pictures at Cannes on April 6. M. Meys is a correspondent of the "Illustration," and was engaged to come down to the Riviera to lecture for the benefit of a charity. He introduced his subject with a short history of colour photography from the time of Daguerre, who, he said, had himself attempted to find a method of photographing in colours, through the more practical attempts of Becquerel and Niepce, to the tricolour theory of Cros and Ducos du Hauron, and its brilliant culmination in the epoch-making process of the brothers Lumière. He also gave a popular explanation of the modus operandi, and answered questions on matters of exposure and technique.

M. Meys' 185 slides ranged over a great variety of subjects. The portraits and figure studies in the open air included some delightful arrangements of colour; not the hard, crude reds and blues with blackish shadows which we have seen, but soft tones blending harmoniously, full of modulation, with perhaps a brilliant colour at the centre of the interest. Very charming was the seaside picture taken from the shore, with a lady in a "squashed strawberry" gown and a little girl in green, by the side of a little rock-bound pool, and in the distance a slightly diffused background of houses. The figures were beautifully posed and placed. Another was a seaside nocturne, or, rather, a picture taken in the gloaming. The lights in the background houses were reflected in brilliant streaks in a little pool on the sands, by which stood a girl in a white dress. The picture, in its peaceful sentiment, as well as in its subject and treatment, strongly recalled a Le Sidaner. Another figure group represented the widow of the famous Jules Breton, being painted out-of-doors by her daughter. A picnic party in light dresses in a wood was a marvel of simple and convincing posing. Each figure—and there were many—occupied the place where they would naturally be looked for—the antithesis of the stiff, heaped-up pyramid that is generally recalled by the word "group."

Another soft yet brilliant picture represented "Zara" leaning against a marble balustrade. Though the sun shone on the white stone floor beside her, while the figure was in the shade, there was a beautiful transparent quality and absence of black throughout the picture.

There were other portraits—beautifully dressed damsels among flowers, contre-jour effects with sunlit parasols, indoor groups, piano portraits, etc.—all showing the same eye for colour and composition.

The landscapes were perhaps less successful. The pale skies were often, I think, out of tone, and I am not as fully satisfied as the lecturer appeared to be that the rendering of greens is quite as it should be. Nevertheless, there were plenty of pictures here too—village scenes, cliffs and moors, the house of Cazin the painter on the edge of a cliff, the same, if I mistake not, which Monet has painted. Then there were the seascapes; one most striking one represented the scarlet hull of a boat next to a deep green one, with purplish reflections in the water—a gorgeous bit of colour! The next was a large rusty anchor hanging from a ship, the face of a girl on the quay forming the immediate foreground. These two reminded me in their composition of some of Coburn's Liverpool monochromes.

Then we had strikingly excellent copies of pictures in museums and houses, including two Goyas and one of a Lyonnais painter named Ancelin, who painted his pictures in dabs of violet, green, and orange, before the Lumières published their process. Then we had still life, flowers, carpets, coppers, biblo's, books, and, finally, some gorgeous sunsets.

On matters of technique the following details were elicited by questions during the lecture or in conversation afterwards. M. Meys habitually uses a Celor lens working at F. 6. He deprecates the use of a smaller aperture, as the less light is used the more likelihood there is of an admixture of black in the colours. I asked him whether double the exposure at F. 8 would not give the same effect, but he seemed a little doubtful; and I notice that Baron von Hübl, in a recent article, states that insufficient lighting or too small an aperture may make it impossible to get pure colours. Most of the pictures were taken in bright sunlight with (between eleven and two o'clock) an exposure of two seconds. Later in the day, or beneath trees, etc., exposure might be fifteen seconds. None of the sunsets, I think, had more than thirty seconds, though I personally have successfully given as much as six or seven minutes at F. 3.8.

All exposures were made by judgment, without the use of an actinometer. Portraits indoors at F. 6 were given generally about two minutes with a good top light, but one sunlit portrait in a window only had four seconds. In this case the sheen on the dress and the light parts were good, but the shadows very heavy. A group of birds in a museum and some pictures had three hours' exposure. The necessity of accurate and full exposure was emphasised.

M. Meys develops in the dark for two and a half minutes, as originally laid down by Messrs. Lumière; he does not risk exposing the plate to a red or green light even to glance at it momentarily. In cases where full exposure has weakened the tint of the light tones he relies on the intensifying bath several times repeated, with a permanganate bath between each repeat. I unfortunately forgot to note which of the two last permanganate baths was the one used.

The exhibition was not only a great treat to witness, but it also exhibited the powers of the Autochrome process in capable hands of giving colour compositions rivalling the pictures of the painter, not only in tone, composition, and colour, but also in those more delicate and subtle qualities, which one is too apt to imagine are inherent in the personal touch of the artist, rather than in his seeing and selecting eye. J. C. Warburg.

THE PREPARATION OF PAPER PRINTS FROM AUTOCHROME PLATES BY MEANS OF THE LEUCO BASES.

Although we have outlined in the following article a method of preparing colour-prints on paper from Autochrome plates in a much simpler way than preparing an actual Autochrome, we are fully alive to the difficulties which stand in the way of the practical execution of our suggestion. The Autochrome has so far baffled all attempts at reproduction on paper except in so far as applies to the three-colour printing methods which are usually considerably simpler and very much better for making prints when the starting-point is a set of negatives taken in a three-colour camera. Everyone who has used Autochrome plates, or is well acquainted with the theory of the latter, knows the difficulties which the Autochrome glass picture offers for photographic or photo-mechanical three-colour reproduction.

At first consiledable hopes were based on the bleach-out process, by which it was anticipated paper prints could be easily made from Autochromes. According to the present stage of this process, however, practically useful results are not to be thought of, as the principal difficulties are in the printing process itself.

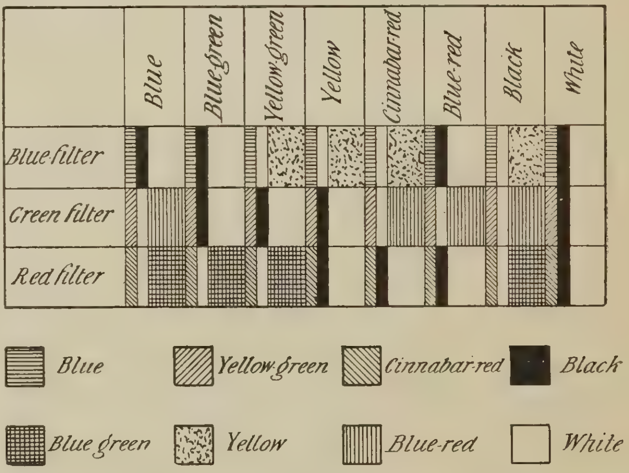
If a printing process is to be used for Autochrome plates, it appears to be more convenient to use Autochrome negatives in the complementary colours. The first advantage of this method is that the black silver deposit, which actually forms the colours in the process, will not produce degradation, but brightening, of the colours of the positive print (since this silver deposit is as strong in the negative as in the reversed positive from it, and the introduction of black in the two reproductions of the positive Autochrome pictures being avoided). The question is now to find a printing process in which the starting-point is the complementary colour negative. This printing process must fulfil the following conditions:—Behind the uncovered filter elements of the negative must be formed the complementary colour. Behind white—that is, behind the filter elements free from protecting silver particles—there must be black, and behind the completely covered parts of the negative there must be formed white.

Now, there are certain colourless chemical compounds, the leuco bases of the organic dyes, which are converted more or less quickly into coloured bodies on exposure to light in the presence of substances (sensitisers) which readily give up oxygen. The colour of these leuco bases is only formed in light of the complementary colour. The properties of the leuco bases have become known in photographic circles by the pinachrome process for three-colour printing, introduced some year or two ago by the Hoechst Dye Works, to whom we are indebted for our experimental material.

The colours formed from the leuco bases are characterised by brilliancy and transparency, so that compound colours can be well reproduced.

If a sheet of paper coated with leuco bases be exposed under a complementary colour negative, there is formed, for instance, under the negative yellow, which would be represented by the blue filter elements, whilst the green and red grains would be more or less covered, a yellow leuco body under negative-blue, in which the blue starch grains, transparent to the light which produces the yellow, would be covered, the yellow leuco body would not be formed.

If a sheet of paper were coated with three suitable leuco bases, it is conceivable that under a complementary-colour negative a correct colour positive might be formed.



The question now is of what kind must be the three leuco dyes to be used with such paper. It is evident that they must stand at equal distances from one another in the "colour circle," for, whether subtractive or additive, they must, when in equal quantities, be colourless. They must also, as Von Hübl says on this point, form a "triad." The colour triad of the Autochrome plate is pure blue, yellow-green, and vermilion; the complementaries to these are yellow, bluish-red, and blue-green; and it is this triad which must be taken into account in printing. Proof is seen in the accompanying diagram. In this the colours blue, blue-green, yellow-green, yellow, vermilion, bluish-red, black and white are represented diagrammatically in the complementary-colour Autochrome negative. The anterior narrow fields represent the three filter grains (blue, yellow-green, vermilion), the narrow fields behind them represent the distribution of the silver deposit behind the individual filter elements, and, finally, the broad fields represent the leuco colours, which are formed behind the respective filter colours in the first line. Naturally, behind the covered starch filters no colour can be formed, and the paper thus at these places remains white. The compound colours of the positive Autochrome plate, i.e., blue-green, yellow, and bluish-red, are expressed in the complementary-colour negative by the pure filter colours red (vermilion), blue, and green (yellow-green), whilst the pure colours of the positive are represented in the negative by compound colours. Since, however, pure colours of the negative are to be represented if possible by colours in the paper print, leuco bases must be used for the paper positive process which give the colours bluish-red, yellow, and blue-green.

An example may replace lengthy explanation of this somewhat complicated consideration. If on the printing surface a leuco pure blue be used, corresponding to the filter blue of the starch grains, this pure blue must be formed behind the red as well as the green filters to reproduce blue objects. There is actually formed, however, this colour in the first line behind yellow; yet the yellow transmitted by the red and green filter elements would scarcely suffice to form this blue sufficiently well. When using bluish-red and blue-green on the printing surface to represent blue, each of these colours would be formed behind its complementary filter, i.e., behind green and red. It is neither expected nor desirable that on the printing surface there should be formed an absolutely exact copy of each individual starch grain in its complementary colour, there should rather be chiefly a substractive mixture of the individual colours, and, therefore, on the basis of the arguments which apply to ordinary three-colour printing, the yellow must be present as a pure colour. If the printing surface, however, contains yellow, the hue of the two other colours of the "triad" is thereby determined.

So far, theory has preceded actual experiments to obtain a paper printing process for Autochrome plates with the leuco bases of the organic dyes. Our practical experiments, made with some leuco bases, have not resulted in anything contradicting our theoretical reasoning. There are numerous difficulties in the working out of this process to a practical useful conclusion. Most important of all is the question whether the leuco bases are to be mixed to form a kind of bleach-out paper or whether, for instance, starch grains of corresponding small size may be impregnated with leuco bases and then mixed as in the preparation of the Autochrome plate itself.

It may not perhaps be easy to find leuco bases which will assume the theoretically correct colours on exposure to light. Also attention must be paid to a fixative for all these leuco bases and their dyes. The great differences in light sensitiveness of the chosen colour bases which at present exist would be a comparatively slight obstacle, for in carrying out the process one could alternately print, or print subsequently, under a blue, yellow-green, or vermilion filter, until the colours in the print were sufficiently differentiated. As it is beyond possibility to find a quick printing process, and as satisfactory control requires a slow formation of the picture, the sensitising of the leuco bases is to be done only to a slight extent. If only one of the dyes is less sensitive than the other two, this can be overcome by covering the printing frame for part of the time of printing with a colour-filter faintly stained with a dye complementary to the colour.

On the basis of the above statements one may say that a solution of the problem of printing Autochrome plates on paper in colours is possible. The solution of the problem cannot be expected immediately, and calls for technical knowledge of a high degree. For this reason we have published these preliminary notes. Such a process, if it is perfected, will supply a practical single-printing method of reproducing the Autochrome pictures. In opposition to the bleach-out process, it will give comparatively permanent pictures, and it will give to the much-admired Autochrome process a universal position amongst all colour processes. To attain this final result, either on the lines sketched out or some others, is to-day one of the most important questions in practical photography.

E. Stenger.
F. Leiber.

PINATYPE PRINTS FROM AUTOCHROME AND OTHER SCREEN-PLATE TRANSPARENCIES.

[The following article in the current number of "La Photographie des Couleurs" deals, as will be seen from its title, with a subject of pre-eminent interest to those engaged in colour photography, and the fact that it embodies the suggestion of M. Léon Didier, the inventor of pinatype, should ensure for it a careful reading.—Eds. "Colour Photography" Supplement.]

The most interesting question at present before those engaged in colour photography is the duplication on paper of results obtained on glass by a single exposure and with a single series of operations. Unfortunately, we have not reached this point, and, therefore, if we are not contented with a single positive transparency, we have to adopt a compromise between the modern one-plate method and the old three-colour process of three separate plates. In other words, we have to split up the picture we have obtained at one exposure either at the positive or negative stage, and to reconstitute it by one or other of the known printing processes. Of these methods the pinatype process, or the modified method of pinatype described in "La Photographie des Couleurs" for May, 1907, and devised by me particularly with a view to this use of it, appears to me to give the best results in the easiest manner. One or other of these processes requires that one should work from a positive transparency, and the original, therefore, is best obtained as a negative.

This is readily attained by developing the Autochrome plate in the usual way, but without proceeding to reverse it. The image will then consist not only of reversed tones, negative instead of positive, but also of colours which are complementary to those in the original. Such a negative includes on a single plate all three of the monochrome colour-sensation negatives. In order to separate one of these—the green, for example—the negative is illuminated by green light. The blue-violet and red components are thus eliminated, and only the portions intended for printing in *minus* green or pink are obtained.

The positive transparencies, which in the original pinatype process are exposed from, and, in the modified pinatype, themselves form the print plates, are thus obtained by copying three times on panchromatic plates the negative Autochrome, each printing operation being done with one or other of the three screens used in three-colour photography. If the printing is done by ordinary pinatype, this reproduction must be made in the camera, otherwise the final image will be reversed. The modified pinatype, however, allows of the reproduction being performed not only in the camera but more easily and practically in the printing frame. The series of operations are, therefore, as follows:—(1) Making the Autochrome negative, (2) preparing the component transparencies, and (3) using these latter in the manner already described in the articles on pinatype.

Making the Negative Autochrome.

Nothing more need be said under this head than that the Autochrome plate is exposed and developed according to the method of MM. Lumière, and, after a brief washing, fixed in the hypo bath. The plate then possesses in reverse the values and colours of the subject. After washing it is given a weak bath of permanganate in order to completely remove the hypo, and is then intensified by the baths F and G, familiar to users of the Autochrome process. After washing it may be well to give it a brief fixation, and after a final wash put it to dry.

Making the Transparencies.

When working with a camera by enlargement or reduction, the glass side of the negative Autochrome must face the lens in the case of modified pinatype, or be turned from the lens in the case of modified pinatype. Otherwise the method of work is the same as in making a lantern-slide from an ordinary negative, save that the colour-screen must be interposed and panchromatic plates used for the transparencies. Moreover, it is better and more certain to work with a printing frame. For this purpose an artificial light, such as a candle, placed at a fixed distance, is employed, and in conjunction with the use of plates of uniform sensitiveness eliminates most of the possible variations in the operation. The exposure having been once determined, and the ratios of the screens being known, it is easy to make any number of transparencies of uniform quality. The ratios of the screens, it should be noted, will be different when working by artificial light from those correct for daylight. The red screen will require the least exposure and the blue-violet the most. It will be found desirable to make the transparency corresponding to the latter screen on an ordinary non-orthochromatic plate, and to prepare it slighter denser than the others, which should be of equal value. The screens may be placed anywhere between the light and the printing frame, either close to the former or in an intermediate position, or close against the Autochrome. I prefer the latter, but it is necessary in this case to have the screen the full size of the Autochrome. The screens can be made by the worker himself by coating well cleaned glasses with solutions of gelatine dyed according to the formulæ of Dr. König by means of the special dyes manufactured by the Hoechst Works. Two similar plates thus prepared are bound together film to film with gummed paper edging.

Formulæ for the Screens.

It may be well here to repeat the method of making these selective screens. A six per cent. solution of gelatine is first prepared by taking the necessary quantity of gelatine, softening it in distilled water, changing the water two or three times, and then, when as much as possible has been squeezed out of the gelatine, placing the whole in a vessel which has been tared on a pair of scales, and adding enough water by weight to give a six per cent. solution. The mixture of gelatine and water is then liquefied on a water-bath, and may be kept for two or three days. The dyes are used in very small quantities, and should therefore be added from stock solutions prepared as follows:—

Blue Solution Stock.

Crystal violet, Hoechst	2 gms.
Distilled water, hot	50 ccs.
Acetic acid	5 to 6 drops.

Six to 7 ccs. of this blue solution are added to 100 ccs. of 6 per cent. gelatine solution.

Green Solution Stock.

Hoechst patent blue	6 gms.
Tartrazine	3 gms.
Distilled water	330 ccs.

The tartrazine is dissolved in hot water, and the blue added when cold. Five ccs. of this green solution are added to 100 ccs. of 6 per cent. gelatine solution.

In place of this green solution a 1 in 30 solution of "special green I" can be used in the proportion of 5 to 6 ccs. for 100 ccs. of gelatine.

Red Solution Stock.

Dianile red (for screens)	5 gms.
Distilled water	200 ccs.

Four ccs. of this solution are added to 100 ccs. of gelatine.

In regard to the plates, I have found that the Jougla "Orthoscopique" has given me the best results. As I have said, I prefer to use an ordinary plate for the yellow printer (blue screen). For developer a solution should be used which will keep the high-lights clean, and give at the same time plenty of density. Hydroquinone, with a good dose of bromide, works well. The transparencies thus obtained will be of the proper value if care is taken to see that the density in portions of the subject of white or neutral colour is the same in each. It will be seen that the transparencies have a certain grain, which is more noticeable in the blue-violet transparency, and is especially pronounced if the positive plates are not fully exposed. If exposure is correct—that is to say, long enough to give all the details of the original, or slightly in excess—a slight halo is produced, which, however, in this particular case, has its use. This halo, while not sufficient to affect the outlines of the subject, has the effect of uniting the different parts of the image, and of transforming them into practically a continuous surface. As regards the printing, the grain, which is still visible in the positive transparency, is absolutely negligible in the final three-colour prints.

Since the Autochrome plate gives at its best only one-third of the colour values of the original, it might be supposed that the pinatype prints would appear flat and degraded. This, however, is not so, and the result is due, firstly, to the scattering from the grains of the image, which has the effect of filling up the interspaces; and, secondly, to the intensification produced by the use of a powerful developer. There is no need to use the methods which have been proposed for the Warner-Powrie process.

I may interpolate here a few precautions particularly applying to the pinatype process, used as I have just suggested. The positive transparencies which serve as the print plates should be fairly strong in contrast, but with good gradation and perfectly pure whites.

The fixing solution should be one of plain hypo without other additions, and should be followed by ample washing. As sensitiser, the following is used for the yellow printer:—

Ammonium bichromate	2½ gms.
Ammonia	20 ccs.
Water	200 ccs.

For the blue and red printers the following:—

Ammonium bichromate	2 gms.
Ammonia	20 ccs.
Water	200 ccs.

The positive transparencies are afterwards set aside to dry (shielded from the light), and are then printed as follows:—The back of the plate having been well cleaned, the plate is placed in a printing frame, gelatine side inwards, and a piece of of printing-out paper laid upon it, just as though an ordinary P.O.P. print were being made. It is then exposed to daylight, which imprints upon the paper a negative image. Exposure is stopped as soon as details commence to show in parts corresponding to the darkest parts of the transparency. This is done in the case of all three transparencies. That of the yellow printer requires exposure about double either of the two others. The after-washing is then done, in order to remove the soluble bichromate, which can be shortened by placing the plates in a little 5 per cent. ammonia. The blue and red dye baths may be used of double strength, say, to 8 per cent., whilst the yellow bath may be kept of the same strength as is customary in ordinary pinatype. In other respects the manipulation is exactly on the lines of this latter process.

As regards registering the prints, the silver image may perhaps cause some little difficulty, but it can be readily removed, either before or after dyeing, by means of Farmer's reducer.

Registration of the print when making the three impressions will be greatly aided if a cross be marked on the original Autochrome for reproduction on the transparencies. It is also a good plan to give the original an opaque edging so that the prints are obtained on a white ground, a thing that could not easily be done by the three-colour method. Finally, it may be pointed out that the relative simplicity of this method of reproducing Autochromes, especially by the modified process, must be obvious to the worker. Three positive transparencies, which, after sensitising with bichromate and subsequent dyeing, can be contacted with a gelatine paper, give an indefinite number of prints of uniform colour rendering. LEON DIDIER.

A MODIFIED METHOD FOR THE ASSEMBLING OF THREE-COLOUR PRINTS ON ROTARY STRIPPING FILM.

[In the current issue of "Das Bild" we find the following particulars as to a modification in the treatment of the carbon-stripping films employed for three-colour printing, and sold in this country by the Rotary Photographic Company, Limited.—EDS. "Colour Photography" Supplement.]

SOME practical experience has led us to modify somewhat the assembling of the three component pictures of the carbon three-colour prints. Our recommendations are the result of some considerable research into the conditions which cause the partial separation of the prints in small portions from the support, notwithstanding the care which may be taken in laying them down. The temperature of the cementing gelatine solution is a considerable factor in this trouble, as is also the manner of cementing the films, and, therefore, the modified method should be particularly interesting to amateur workers, to whom this part of the process offers some difficulties. Moreover, it sometimes happens that the complete prints are mounted with the aid of a solution of glycerine, or this latter substance added to the gelatine cementing solution or other adhesive in order to give flexibility to the finished print, and to prevent any possibility of it leaving its support. A warning, however, should be uttered as to the addition of glycerine or other hygroscopic substance, inasmuch as the permanence of the colours has been shown to be prejudiced by this variation in the process. If the formula now to be given for the assemblage of the three prints be followed carefully, separation of the films will never occur. Distortion or buckling of the mount can be avoided by pasting a sheet of stout paper to the back.

The finished print should not be cut within the borders of the picture; the cut favours the separation of the films in dry air.

We will now pass to the method of cementing recommended, assuming that the yellow print is first transferred. The yellow print is softened for about a quarter of an hour in water at 80deg. to 90deg. F. This done the three-colour transfer paper is placed for about five minutes in water at 65deg. to 80deg. F., and the pigment film brought under water in contact with the transfer paper, film to film. The two are drawn out of the water together and laid, paper side under, on a smooth surface covered with one or two thicknesses of filter paper. A piece of filter paper—or, better still, a thin film of celluloid—is laid on the top and rubbed over with a soft towel. The print, thus united with the transfer paper, is put between two glass plates under slight pressure for a quarter of an hour, the pressure being conveniently applied with a few clips. At the end of this time the print and transfer paper are hung up together in the air and allowed to dry at the ordinary temperature. The yellow pigment film will stand a decent amount of pressure, and therefore the above described process can be carried out with the aid of a press, or with an ordinary frame fitted with strong springs. Such, however, should not be used in the case of the red and blue films. It is inadvisable to hasten drying by a greater heat than 70deg. F., as the gelatine film then dries too quickly, and the paper, on subsequently soaking in water, does not expand to the full. Moreover, the separating film is injured by too warm drying and obstructs thus the stripping of the celluloid; it is best, therefore, to dry at a moderate temperature with the aid of a ventilator.

After drying of the yellow print the celluloid support is removed, the picture rubbed over with a tuft of cotton wool moistened with benzole, and the transfer of the blue film then proceeded with in a somewhat similar manner. This pigment film should also be allowed to rest for a quarter of an hour in water of from 80deg. to 90deg. F., whilst the mounted yellow print is laid in water at 65deg. to 70deg. until it has completely expanded. The blue and yellow pigment images are then brought together in contact in the gelatine solution.

The process is so adjusted that after the softening of the yellow paper print this latter, with the blue pigment film, is hardened for a few minutes in a 3 per cent. formaline solution. On removal from this solution the prints are allowed to drain, but, without being rinsed are laid near each other on a thick piece of mirror glass, which has been previously warmed in water of about 110deg. F. The previous warming of the glass is an important part of the manipulation, as otherwise the cementing gelatine cools too quickly and its adhesion is thus upset, causing a subsequent separation of the component films. For these reasons the cementing process should be done in a well-warmed room. Both prints are then coated, with exclusion of air bubbles, with a 3 to 4 per cent. solution of gelatine (soft emulsion gelatine) at 115deg. F., after which the blue pigment picture is, after the removal of any remaining air bubbles, taken up and quickly laid down on the yellow print. The whole is then covered with a large piece of celluloid and gone over quite lightly with the hand or with a rubber squeegee in order to remove excess of gelatine solution. If any air bubbles should be imprisoned between the two pictures they should be driven out by lightly rubbing with the point of the finger on the edges of the prints. If the squeegeeing is done too vigorously, too much gelatine will be expelled, and the prints will be sufficiently starved of adhesive to adhere badly. The blue print is now registered by hand, and left under pressure between two glasses for a quarter of an hour. After the gelatine has set the combined print is taken from the glass plate and pinned up to dry. After drying, which should not be done with the assistance of immoderate heat, the celluloid support is stripped off from the now greenish-looking print, and the surface, as before, gone over with cotton wool moistened with benzole. The mounting of the red print is done in exactly the same way.

The three component prints having been united to a whole, the surface is again rubbed over with benzole, immersed in cold water, and attached to the mounting board with paste. Any mechanical defects in the film should be made good by the aid of the three-colour retouching colours, and great brilliance and richness given to the pictures by coating with a solution of three-colour varnish, which protects any retouching and renders it invisible.

THE BLEACH-OUT ACTION OF LIGHT ON DYES.

[The following paper in the "Annalen der Physik," Vol. 24, No. 14, p. 661, although not of very recent date, has not yet been translated in full, and, therefore, in view of the growing interest in bleach-out processes of colour photography, we may very properly place the results arrived at by P. Lasareff before English workers.—Eds. "Colour Photography" Supplement.]

The quantitative measurements of the action which light exerts on dyes possess an interest for students of physical chemistry[1] as well as in physiology[2] and in peripherical vision.[3] In the many experiments which have been made in the photo-chemistry of dyes,[4] either white light or light coming through a filter has been used; a closer examination of the optical properties of dyes has not been undertaken. The purpose of the following paper is, therefore, to fill in the gaps in the visible spectrum, and to ascertain the relation of the decomposd dye to its absorption constants and to the wave-length of the light falling upon it.

Preliminary Experiments.

In order to select from a great number of dyes those in which the change takes place fairly quickly, the bleaching of the dyes was first tested by the white light of a Nernst lamp. The following proved suitable:—Cyanin,[5] lepidin-cyanin, pinacyanol, pinaverdol, chinaldin-cyanin, and pinachrome[6], and were examined in collodion films.

The collodion films were prepared by coating a cover-glass (18 + 18 mm.) with a solution containing collodion, 1 part; ethyl alcohol, 1 part; ether, 1 part, and drying protected from dust. The films were dyed either by addition of an alcoholic solution of the dye to the collodion or by bathing the films in an alcoholic dye solution. The dried dyed films keep for a year or more without visible alteration.

On exposing a dyed film in the spectrum of a Nernst lamp for two to four days the dye bleaches out completely in the region of the absorption bands, whilst in other portions it shows no noticeable difference. The film bleached in this way exhibits no visible change on being kept for a year in the dark.

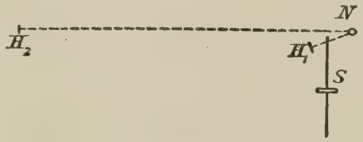


Fig. 1.

In order to decide if the bleaching action is the result only of the energy received by the film, and is independent of the intensity of light, the following series of experiments was made:—A cover-glass, coated with the dyed film, was cut into two pieces. One, H_1, was placed 10 cm. from a Nernst lamp, N, the other, H_2, 100 cm. distant. In front of the film H_1 a quickly rotating opaque screen, S, was placed, in which was cut a sector of :01 of the circular screen. The relative intensities of light were 1:100, but the energy reaching the two films was equal. The bleaching action was found equal in both cases.

From experiments with pure dye films, which were prepared according to Pflüger[7] without a vehicle, it was ascertained that such films, when examined under the microscope, showed a grain structure, that they absorb light not as optically homogeneous bodies, and give irregularities in bleaching which appear to be independent of the granular structure of the film.

Methods of Examination.

In order to be able to take photometric measurements of the quantity of absorbed light, and, therefrom, of the proportion of undecomposed dye in the dyed film, during the bleaching action by different parts of the spectrum, the arrangement shown in Fig. 2 was used. The horizontal filament of a Nernst lamp (.5 amp.) was placed at the focus of the lens A, the parallel rays therefrom allowed to pass through the direct vision prism, P, and formed as a spectrum on the cover-glass, G, attached to the prism. A König-Marten spectrophotometer[8] K.M. is so arranged that the slit is 1 to 2 mm. behind the cover-glass G, and the rays of the Nernst lamp fall on the collimator tube of the photometer. In front of one slit is the dyed half of the cover-glass; in front of the other, the other half of the glass with the film removed. The table E and the screw F allow of the spectrum apparatus being turned round the horizontal axis H, which passes through the horizontal diameter of the lens B. The photometric measurement can be made in different parts of the dyed film in the light falling on the latter. The wave-length of the incident light is measured with sufficient accuracy by the screw T.

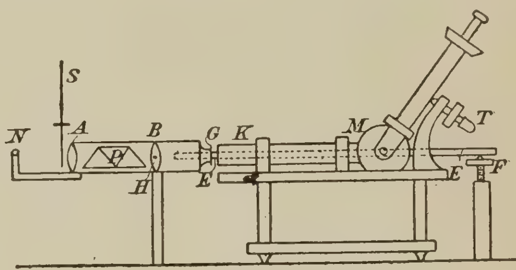


Fig. 2.

For photometric measurements the light was reduced to $\frac{1}{18}$ or to $\frac{1}{36}$ by interposing (during the measurements) a quickly rotating screen, SL, with a sector opening of the proper size before the lens A.

In order to ascertain the distribution of energy in the spectrum, the photometer (Fig. 2) was shifted back, and a line Rubens thermo-pile placed firmly parallel with the photometer slit. By raising and lowering the set screw F the various regions of the spectrum were brought on to the thermo-pile.

To ascertain the corresponding wave-lengths the viewing-tube of the photometer, with a Gauss eye-piece attached, was shifted by means of the screw T until the image of the surface of the thermopile coincided with the middle of the slit of the eye-piece. The wave-length was then read off on T with sufficient accuracy. The energy was measured by means of a sensitive galvanometer.

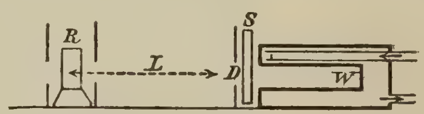


Fig. 3.

The absolute measurement of the radiant energy was done according to R. v. Helmoltz[9] by the use of the radiation constant measured by Kurlbaum.[10] The apparatus shown in

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[1] W. Nernst. "Theor. Chemie.," p. 767, Stuttgart, 1906-1907. R. Luther. "Zeit. für Wiss. Phot. Z." (1905). p. 1905.

[2] C. Timiriazeff, "Proc. Roy. Soc." London. 72. p. 424. 1904.

[3] W. Trendelenburg. "Zeit. für Psychol. de Physiol." 37. p. 61. 1904.

[4] See "Fortschr. der Physik," from 1892–1906.

[5] From Grübler of Leipsic.

[6] From Meister, Lucius and Brüning, Hoescht a. M.

[7] A. Pflüger. "Wied. Ann.," 65, p. 181. 1898.

[8] F. F. Martens. "Verhandl. de Deutsch. Physik. Gesellsch." I., p. 280, 1839. F. F. Martens und F. Grünbaum. "Ann. der Phys.," 12, p. 984, 1903.

[9] R. v. Helmoltz. "Die Licht und Wärme-Strahlung verbrennender Gäse" Berlin. 1890. p. 12.

[10] F. Kurlbaum. "Wied. Ann.," 65. p. 759. 1898.

Fig. 3 served as an absolutely black body. A blackened brass tube, W, of 2 cm. diameter, is heated in a steam jacket to 100 deg. C. In front of the tube is a circular diaphragm, D, of 1.6 cm. diameter, behind which a removable screen is let drop. At the distance, L, of 8.4 cm. from the diaphragm D the thermopile R is placed. At this spot the intensity of radiation E is:—

$$E = \frac{\sigma [T_1{}^4 - T_2{}^4] D^2}{4 L^2} \quad \frac{\text{gm-Cal}}{\text{cm}^2 \text{ sec}}$$

As the radiation constants (according to Kurlbaum) are

$$\sigma = 1{\cdot}28.10^{-12} \vee T_1 = 373^\circ \text{ abs and } T_2 = 293{\cdot}5^\circ \text{ abs.}$$

$$E = 1{\cdot}39{\cdot}10^{-4} \frac{\text{gm-Cal}}{\text{cm}^2 \text{ sec}}$$

this intensity of radiation corresponds with a galvanometer (feat) of about 14 Skb. The radiation intensities in the spectrum lie between

$$E_1 = 2\,08{\cdot}10^{-4} \frac{\text{gm}-\text{Cal}}{\text{cm}^2 \text{ sec}} \text{ (for } \lambda_1 = 530\ \mu\,\mu)$$

and

$$E = 12{\cdot}81{\cdot}10^{-4} \frac{\text{gm}-\text{Cal}}{\text{cm}^2 \text{ sec}} \text{ (for } \lambda = 648\ \mu\,\mu)$$

The galvanometer feats were taken at 10 points, and the curve of the energy of the spectrum obtained graphically from these data.

Experiments.

The measurements of the decomposed dyes were made photometrically as follows:—Denoting the ratio of the intensities of the two fields for a given wave-length (by J_0) when an uncoated glass plate is placed before the photometer slit, and that by J_1 when a glass half-coated with dyed collodion is placed in front of the slit, and that by J_2 when after a certain time, Δt the bleaching action has taken place, we obtain (disregarding the slight difference in reflecting power of the coated and uncoated glass):—

$$\frac{J_1}{J_0} = e^{-KC}, \text{ i.e., } KC = \frac{\log J_0 - \log J_1}{\log e}$$

$$\frac{J_2}{J_0} = e^{-K(C-\Delta C)}, \text{ i.e., } K(C - \Delta C) = \frac{\log J_0 - \log J_2}{\log e}$$

where K is a characteristic constant for the collodion film and the respective wave-length, C the concentration of the dye solution, and ΔC the reduction in the concentration by the bleaching action of the light.

The alteration in the proportion of dye due to the decomposition is

$$\frac{\Delta C}{C} = \frac{\log J_2 - \log J_1}{\log J_0 - \log J_1}$$

Given the proportion of incident radiant energy E for the respective wave-length, the dyed film at the commencement of the experiment absorbs the energy e_1

$$e_1 = E\left(1 - \frac{J_1}{J_0}\right)$$

and at the end of the experiment the energy e_2,

$$e_2 = E\left(1 - \frac{J_2}{J_0}\right)$$

As the quantities J_1 and J_2 differ but little from one another, the total value of Q of the energy absorbed in bleaching during the time Δt can be placed as a first approximation of sufficient accuracy at

$$Q = \left(1 - \frac{J_1 + J_2}{2 J_0}\right) \Delta t.$$

and E can be taken from the energy curve of the spectrum.

The experiments were made as follows:—The rotating sector screen S (Fig. 2) was set up and the intensities J_0 ascertained by 1 to 4 readings for a series of wave-lengths read off at T. Next the cover-glass with dyed collodion film was put in and the measurements of intensities J_1 taken in the same way for the same wave-lengths. The screen S was then removed and the film exposed to the unscreened light for 3 to 17 minutes, the screen again inserted, and the intensities J_2 measured for the same wave-lengths.

The intensities J_0 were practically identical. The intensities J_1 in the absorption maximum of the collodion film amounted to about .2 to .9, and the bleach-out action was adjusted so that ratio $J_1 : J_2$ was about .9 to .7. Remembering that as the measurements can be made in a mean of within ± .3 to .5 per cent., the measurement of $\Delta C/C$ is accurate in the absorption maximum to about 15 per cent.

The series of measurements of J_1 and J_2 took about three minutes, the bleaching action from three to seventeen minutes. As the photometric measurements were done with light of $\frac{1}{18}$ to $\frac{1}{38}$ the strength, further alteration of the film was not possible, the more so that the series of measurements in the two series were very similar.

The results of the measurements for different wave-lengths λ are given in the tables for the different dyes, in which the ratios J_1/J_0 and J_2/J_0 are given, as well as the calculated fraction $\Delta C/C$ of the bleached dye. Also, the measured radiant intensities E for the different wave-lengths and the proportions of energy Q (in gm-cals) absorbed during the experiments are also given.

The results can be epitomised as follows:—Within errors of observation the decomposed dye in an absorption band is directly proportional to the absorbed energy, and independent of the wave-length of the incident light.

In order to ascertain how great is the radiant energy necessary for the decomposition of 1 gm dye, collodion solutions of definite strength of dye were coated on large glass surfaces in uniform films. The area was ascertained and the dye per sq. cm. calculated. The dried film was then exposed to the spectrum, as already described, and the dye decomposed in a certain time ascertained, in addition to the energy absorbed in this time. The energy spent in the decomposition of 1 gm. of dye would thus be calculated. The results were as follows:—

Chinaldin-cyanin	16,000	gm—cals. / gm—dye.
Pinachrome	30 000	
Cyanin	48,000	
Lepidin-Cyanin	58,000	
Pinaverdol	117,000	

Comparing the above data with the heat of combustion of organic bodies, it would seem that only a small fraction of the absorbed radiant energy is used in the photo-chemical decomposition of the dye. The larger part is spent in warming the absorbent film.

TABLE I.

Cyanin (Time of Bleaching, 3 min.).

λ in μ μ	554	573	593	604	617	642
J_1/J_0	0,759	0,569	0,495	C,542	0,640	0,893
J_2/J_0	0,769	0,610	0,566	0,624	0,701	0,906
E.g —Cal./cm² sec	$3,47{\cdot}10^{-4}$	$4,51{\cdot}10^{-4}$	$6,25{\cdot}10^{-4}$	$7,29{\cdot}10^{-4}$	$9,02\ 10^{-4}$	$13,53{\cdot}10^{-4}$
$\Delta C/C$	0,05	0,12	0,19	0,23	0,21	0,12
Q.g.—Cal./cm²	0,0147	0,0334	0,0529	0,0547	0,0536	0,0246
$K.\Delta C/K_m \Delta C_m$	0,10	0,49	0,95	1,00	0,66	0,10
$KQ/K_m Q_m$	0,11	0,51	1,00	0,90	0,65	0,07

TABLE II.

Pinachrom (Time of Bleaching, 4 min.).

λ in μ μ	536	554	574	584	596	620
J_1/J_0	0,811	0,805	0,711	0,703	0,813	0,939
J_2/J_0	0.822	0,815	0,753	0,746	0,834	0,989
E g —Cal./cm²sec.	$1,0{\cdot}10^{-4}$	$1,3{\cdot}10^{-4}$	$1,9{\cdot}10^{-4}$	$2,2{\cdot}10^{-4}$	$2,7{\cdot}10^{-4}$	$3,8{\cdot}10^{-4}$
$\Delta C/C$	0,07	0,05	0,17	0,17	0,12	0,00
Q.g.—Cal./cm²	0,0044	0,0059	0,0122	0,0146	0,0115	0,001
$K\Delta C/K_m \Delta C_m$	0,23	0,19	0,96	1.00	0,42	0,00
$KQ/K_m Q_m$	0,18	0,25	0,81	1,00	0,46	0,00

TABLE III.

Lepidincyanin (Time of Bleaching 6 min.).

λ in μ μ	536	554	574	596	620	648
J_1/J_0	0,843	0,750	0,603	0,514	0,752	1,00
J_2/J_0	0,843	0,764	0,632	0,583	0,802	1,00
E.g.—Cal./cm² sec.	$1{,}04\cdot10^{-4}$	$1.46\ 10^{-4}$	$1.87\ 10^{-4}$	$2\ 50\cdot10^{-4}$	$3{,}33\ 10^{-4}$	$5{,}41\cdot10^{-4}$
$\Delta C/C$	0,00	0,06	0,10	0,19	0,23	0,00
Q, g—Cal./cm²	0,0059	0,0128	0 0257	0,0406	0.0267	0,0000
$K\Delta C/K_m\Delta C_m$	0,00	0,15	0,38	1,00	0 51	0,00
KQ/K_mQ_m	0,04	0,14	0,48	1,00	0,28	0,00

TABLE IV.

Chinaldincyanin (Time of Bleaching, 16 min. 40 sec.).

λ in μ μ.	536	554	574	596	620
J_1/J_0	0,190	0,113	0,111	0,634	0,957
J_2/J_0	0,221	0,146	0,160	0,695	0,957
E.g —Cal., cm.² sec.	$1{,}04\cdot10^{-4}$	$1{,}46\cdot10^{-4}$	$1{,}87\cdot10^{-4}$	$2{,}50\cdot10^{-4}$	$3{,}33\cdot10^{-4}$
$\Delta C/C$	0,09	0,12	0,17	0,20	0,00
Q.g.—Cal./cm²	0,083	0,127	0,162	0,084	0,014
$K\Delta C/K_m\Delta C_m$	0,41	0,71	1,00	0,25	0,00
KQ/K_mQ_m	0,39	0,78	1,00	0,11	0,00

TABLE V.

Pinaverdol (Time of Bleaching 15 min.).

λ in μ μ	536	554	574	596	620
J_1/J_0	0,376	0,210	0,241	0,794	0,964
J_2/J_0	0,392	0,242	0,291	0,805	0 966
E g.—Cal./cm² sec	$1{,}04\cdot10^{-4}$	$1{,}46\cdot10^{-4}$	$1{,}87\cdot10^{-4}$	$2{,}50\cdot10^{-}$	$3{,}33\cdot10^{-4}$
$\Delta C/C$	0,04	0.09	0 13	0,06	0,06
Q.g.—Cal./cm²	0,058	0,102	0,124	0,045	0,010
$K\Delta C/K_m\Delta C_m$	0,22	0,74	1,00	0,07	0,01
KQ/K_mQ_m	0,32	0,90	1,00	0,06	0,00

TABLE VI.

Mixture of Pinaverdol + Pinacyanol (Time of Bleaching 10 min.).

λ in μ μ	554	566	568	573	582	593	604	630
J_1/J_0	0,372	0,288	0,277	0,310	0,512	0,372	0,279	0,671
J_2/J_0	0,461	0,432	0,447	0,447	0,569	0,589	0,548	0,719
E.g.—Cal./cm² sec.	$3{,}47\cdot10^{-4}$	$3{,}82\cdot10^{-4}$	$4{,}16\cdot10^{-4}$	$4{,}51\cdot10^{-4}$	$5{,}21\cdot10^{-4}$	$6{,}25\cdot10^{-4}$	$7{,}29\cdot10^{-4}$	$11{,}10\cdot10^{-4}$
$\Delta C/C$	0,22	0,32	0,37	0,31	0,16	0,46	0,53	0,17
Q.g.—Cal./ m²	0,122	0.147	0.159	0,168	0.144	0,195	0,257	0,203
$K\Delta C/K_m\Delta C_m$	0,32	0,60	0,70	0,54	0,16	0,68	1,00	0,16
KQ/K_mQ_m	0,37	0,56	0,62	0,60	0,29	0,59	1,00	0,25

P. LASAREFF.

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THE GRADATION OF PLATES IN DIFFERENT COLOURED LIGHTS.

DR. R. LOHMEYER has published, in the "Zeitschrift für Reproduktions-technik," a lengthy paper on the above subject, using both bathed and emulsion-dyed plates. The article is illustrated by numerous curves and tables, which do not permit of useful abstraction, but the following are the author's conclusions drawn from his results:—

1. All curves begin with a convex part curved to the abscissæ, and then pass through the point of flection to a part which is concave. The transition is in many cases so gradual that there is a straight line portion between the two curves. It is possible therefore to divide the curve into three parts. These three parts correspond to the three stages which are photographically known as under-, normal-, and over-exposure, and these three stages are found with every wave-length, whether these are those of the characteristic maximum of the plate, of the colour-sensitiveness, or a minimum. (*a*) The more rapidly the curve passes from the first to the second phase and the greater the whole curve, the higher the sensitiveness of the plate; the longer the straight part the better the gradation, even with great differences of exposure. (*b*) The more gradual the transition from the second to the third stage the greater the latitude of the plate and its value for practical work.

2. There is an exposure of maximum action for every wave-length, and when this is passed the activity of this kind of light is exhausted, even with increase of exposure. There must be, therefore, particles of different sensitiveness in the film.

3. With sensitised plates the characteristic silver bromide maximum and that of the dye can always be seen. (*a*) Independently of any slight fogging action a dye may shift the blue maximum towards the green. (*b*) The dye also influences the original gradation of the plate, so that the gradation of the blue maximum runs more or less parallel to that of the dye. (*c*) This action decreases with increase of spectral separation of the absorption band of the sensitiser from the silver bromide maximum. It is most striking with an erythrosine bathed plate, whilst with a dimethyl-chinoline blue plate, where the distance of the maxima is very great, the maxima curves, even in the phase of normal exposure, cut one another. This difference of gradation can be even seen in an eosine plate, though not very markedly. (*d*) The addition of a second dye with an absorption between the characteristic maximum of the plate and the first sensitiser makes the curves again parallel. Efforts to utilise as many parts of the spectrum as possible, and to lessen the minima has thus the further advantage of giving a better total gradation.

4. The maxima of the eosines give a comparatively hard gradation in the normal region, and almost no gradation in the region of over-exposure. The cyanines not only work much softer, but their gradation can be used further in the over and under-exposed parts, as the transition is more gradual.

5. No marked difference was found between the emulsion-dyed and bathed plates as regards gradation, but merely a shift of the maxima of the sensitiveness curves.

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Correspondence.

*** *Correspondents should never write on both sides of the paper. No notice is taken of communications unless the names and addresses of the writers are given.*

*** *We do not undertake responsibility for the opinions expressed by our correspondents.*

AUTOCHROME PHOTOGRAPHY FOR THE TOURIST.

To the Editors.

Gentlemen,—Now that we are hoping for warmer days and thinking about summer outings it would help many who are interested in the new Autochrome plate if you would give us some hints for its use by tourists. It would be a great advantage to develop the plates on the spot, but it is obviously impossible to take on one's travels the large number of solutions recommended by Messrs. Lumière. One of your correspondents recently told us that the Autochrome plate can be successfully treated with two solutions only—a rodinal developer and the C reversing solution. I have not had the opportunity of testing this for myself, but if your correspondent's conclusions are confirmed by the experience of others the traveller's outfit will be very much lightened, and the development of Autochromes on tour comes at once "within the range of practical politics." Rodinal is the easiest possible reagent to use on a journey, and the "Almanac" for 1908 contains suggestions which will make it a specially handy developer for the tourist.

Is it possible, I should like to ask, to put up the reversing solution C into a handy form for travel? Does it keep well, and can it be used over and over again with impunity?

Then will a few inches of magnesium wire do as well as daylight for the traveller who finds impossibilities for development at his hotel, except in his bedroom at night? Or do any of the new daylight developing machines meet his often hard case?

An answer to these questions, and such as these, would, I am sure, help many besides myself, who look forward with constant pleasure to the monthly appearance of your "Colour Photography" Supplement.—I am, Sirs, yours, etc., J. M. J.

[We have had very little experience of the two-solution method of treating Autochromes, but others have used it, and we see no reason why it should not be successful. If intensification proves to be necessary it can easily be done at a later time. The C solution could no doubt be applied in the form of tablets, and we believe that one firm already supply it in this form. Magnesium ribbon can certainly be used for exposure, and we often find it convenient at night. Messrs. Beck have introduced a tank for developing Autochromes that could be used in daylight with the help of a changing bag.—EDS. "Colour Photography" Supplement.]

No. 18. Vol. II. JUNE 5, 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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THE SOCIETY OF COLOUR PHOTOGRAPHERS' EXHIBITION.

[As we have already announced, the Exhibition of the Society of Colour Photographers remains open at the house of "The British Journal of Photography" until June 27. The exhibition is open from 10 a.m. to 8 p.m. daily, except Saturdays, when it closes at 5 o'clock. A charge of sixpence is made for admission, and a detailed catalogue of the exhibits is given to each visitor. The following review by Mr. E. J. Wall, F.R.P.S., will show the variety of work in colour photography on glass and paper which has been brought together.—EDS. "Colour Photography" Supplement.]

CONSIDERING that it is but seven months since the Society of Colour Photographers held their last exhibition in the same place, one cannot help thinking that it is somewhat of a bold experiment now to hold another show, with an admission fee, and yet the action is certainly justified. That there has been a marked advance, particularly in the use of Autochrome plates, is obvious to any one who can recall the previous exhibition. Noticeably one has got away to a great extent from the stiffly arranged bunch—not bouquet, please!—of garish study flowers, chosen rather because they comprised every spectral and non-spectral colour, with no more pretence of arrangement than the contrasting of complementary colours. How much of this improvement is due to the exhibitor, and how much to the selection committee, one cannot say; in any case, there is a marked improvement.

Three-Colour Carbons.

Thanks either to the exhibitors or those who are responsible for the catalogue, one can in most cases tell what particular process has been used for printing at least.

Mr. Walker Munro's exhibits are curiously unequal. No. 1, an exterior of an old house, possesses a peculiar liquid transparency that is very striking, and, taken on the whole, it is harmonious in colouring, whereas No. 2 shows a most curious patchy colouring. One must, of course, suppose that Mr. Munro knew the subject, and was satisfied with his rendering, as must also have been the selecting committee; but, personally, I find it difficult to account for the colouring.

M. Heuss's exhibits are very unequal. No. 7, a study of cherries, and No. 10, a poster, are the best, the latter being particularly striking in effect.

I hope Mr. Fairfield will forgive me if I suggest that whilst his yellow roses are excellent his greens are hopelessly wrong, which may be either an error in his screens or his printing.

No. 12, a portrait, is the best of Mr. Donaldson's prints, the next being spoilt by a preponderance of red. For an accurate rendering of flowers, No. 17, "Gladioli," by M. Achille Carrara, is excellent. This is lent by Dr. Kenneth Mees, and one would wish that more by the same worker had been sent in.

Mr. Henry J. Comley is, as is well known, the hon. secretary of the Society of Colour Photographers. Practically, the society owes its formation to his enthusiasm, and one, therefore, might be inclined to be lenient to his exhibits were it necessary; but if one wanted a good example of the verity of the old saying that "he who drives fat cattle must himself be fat"—a saying, by-the-bye, which is particularly false—then one might point to Mr. Comley's exhibits. We all know his still-life subjects and portraits; but this year he has given us not only some excellent flower studies, but, above all things, some landscapes. The latter prove him an expert worker, and the only unfortunate thing, from Mr. Comley's point of view, is that he has now to live up to No. 22. He gives us no indication of when this was taken, but it is the clear, tender green of spring, unspoilt by the dust of the motor-car. This is in its way as fine an example of the use of colour photography as Mr. Warburg's [illegible]pes in Autochromes. There are technical faults in Mr. Com[illegible]'s exhibits, but it would be captious to draw particular attention to these. After his landscapes, the still-life subjects, excellent as they are, are unsatisfactory.

We next come to the exhibits of the Rotary Photographic Co., which, technically, are excellent. Unquestionably, the portraits are the best; one feels that here one really sees the Kaiser and Kaiserin, and Professor Ostwald is no less happy. With regard to the copies of paintings and still life, excellent as may be one's memory of the actual paintings themselves, looking at these from the critical, technical point of view, then actual comparison is required.

The above may seem somewhat contradictory, but actually it is not so. Take, for instance, the portrait of the Kaiser. Here one feels that, irrespective of any minor faults—I do not say that such actually exist—one feels that here one has the "Overlord," the total impression is a good portrait, whilst in the case of the pictures one naturally treats these as more or less perfect reproductions of a given subject, and from this plane wishes to compare the original with the reproduction.

Pinatype Prints.

The colouring in Mr. Oneto's exhibit may be typical of Western Australian vegetation, but it does not strike familiarly on an English eye.

The exhibit by Meister Lucius and Brüning is interesting because one may presumably look upon it as the high-water mark of the particular process. No. 48 is especially worth noting, because the same subject is shown amongst the transparencies, and one has thus opportunity to compare the rendering of the same subject on paper and glass. No. 51 is, I think, the best. To those who have any memory of past work, or who may happen to have Penrose's Pictorial Annual for 1906-7, No. 45 is worth notice, because one has the chance of comparing it with the reproduction in three-colour half-tone in the above-mentioned work. Undoubtedly the half-tone is a long way superior in brilliancy and cleanness. There is a dinginess about the pinatype print which is very marked. The superiority of the half-tone may, of course, be due to fine etching.

M. Callier's print is good, but Mr. Beech Williams' print rather shows a loss of colour in parts, which may be due to the transparency or the print plate. For the former, backed plates are to be preferred.

Mr. E. T. Butler's modified pinatype prints are not so successful as others that we have seen by his pre-dyed film process; there seems a lack of brilliancy and light, which is particularly noticeable in No. 59.

Mr. Burchardt is still faithful to his bichromated size and artist's colours, which were described in the "Colour Photography" Supplement for April 5, 1907. Personally, his exhibits this year have precisely the same fault as those of last year. There is a want of drawing in them. No. 61 is far too blue and the yellow too weak, so that there is a want of green. Mr. Burchardt may be perfectly justified in producing such "impressions," for so one may call them, but one would rather like to see a print by this process rivalling in depth and colour some others on the same walls.

Mr. Manners has some really excellent work. Some are undoubtedly by a carbon process, but others do not seem to be. It is a pity that the processes are not stated in all cases, for such an exhibition is to a great extent educational, and all information is desirable. The rendering of some apples in No. 68 is exquisite.

The only example by the Sanger-Shepherd imbibition process is not a success. What this process can do was well shown by an exhibit in the 1906 exhibition arranged by the Editor of the "B.J."

The example of the bleach-out process is also a failure, though whether this be due to the paper or the transparency one cannot say. Mr. John Riley's three-colour Sinop prints are technically quite up to his standard of last year, though the subjects are not quite so pleasing.

Reproductions of Autochromes.

This is a particularly interesting class, because one may learn to some extent the possibilities of using Autochromes as matrices for prints.

M. Léon Didier, the actual inventor of the pinatype process, shows some reproductions by this process which are distinctly promising, but are still lacking in something. They are certainly better than the "Uto" bleach-out print by Mr. Fairfield. The three-colour half-tones from Autochromes are very interesting, particularly those from the L.C.C. School of Photo-Engraving. The reproductions from Messrs. Langdon Coburn's and Steichen's Autochromes cannot be judged from any other standpoint than successful results produced by the block-maker and printers—that is, they cannot be judged as pure Autochrome reproductions,—at least, I do not think so, because on careful examination with a glass a black key seems to have been used. If this is the case it destroys at once all the value of the prints except as pictures.

There is also a frame showing the negative and positive on a Warner-Powrie plate, which has already appeared in Penrose's Annual. The diagrams by Mr. E. A. Salt explanatory of the Autochrome plate are very instructive.

Autochrome Transparencies.

It is interesting to mark that the Autochrome plate is being used more for landscape work. Most of the examples shown are instructive, and some prove how valuable a tool a colour-plate can be in competent hands. I take no credit to myself for any improvement, but I may at least be permitted to point out that in my notes on the exhibition of last autumn I emphasised the fact that the average photographer must unlearn a great many of his practised artistic canons and learn somewhat more of the value of colours. Absolutely the same opinion has been well expressed by Mr. J. C. Warburg quite recently when writing in another photographic journal, for he says: "The first impulse of all photographers who were able to obtain Autochrome plates appears to have been to ransack larder and garden, and gather all the brightest and most varied coloured objects they could lay hands on. These, fearfully grouped upon a scarlet or bright green cloth (with an actinometer hidden from view behind one of the vases), were tremblingly focussed and exposed till the actinometer showed that they were properly cooked. May one who has sought colour-blindness and monochromatic vision for many years urge upon his colleagues in affliction the necessity of treading warily in this new and brilliant path, remembering that harmony is as important in colour as in tone, while a discord is more painful in the former case; that contrasts are as valuable, in the right place, as contrasts of light and shade, and even more telling; and that, finally, although in a colour picture scheme is the first essential, yet composition and light and shade have also to be considered?"

These are weighty words, and it is interesting to see how far the author has applied in practice his preaching. Personally, I should place his landscape Autochromes as the finest examples in the exhibition, and the best examples of how to use the Autochrome plate. It is difficult to say which is the best of his exhibits—that is, which is the one that carries out in practice his advice to his "colleagues in affliction." Nos. 108, 111, 113, and 118 struck me most, and particularly 113. These all made me inclined to forget that an Autochrome plate was used. What I mean is, there is in each a colour scheme, which makes each picture, and one is justified in calling them pictures, a restful harmonious sketch. There is no ransacking nature to find "all the brightest and most varied coloured objects," but a pleasingly selected picture, restful in its colouring. Another equally successful picture is No. 151—a mere study of a gorse bush—by Dr. Rosenheim.

It is in such subjects the future of the Autochrome plate lies, outside, naturally, its purely scientific uses, of which there are many excellent examples.

One may be permitted, possibly, to question whether the illuminant chosen by the organisers of the exhibition is the best for showing Autochrome pictures. It is some sort of incandescent electric lighting, and one which is, therefore, obviously far too rich in red and yellow. It is an open question whether it would not have been better to have placed in front of the lights a pale blue or blue-green screen, so as to have simulated more nearly the colour of daylight. I am well aware that this might not be an easy matter, but I am led to draw attention to this point from an examination of many Autochromes by the electric incandescent light, and immediately thereafter an examination of the same by acetylene, screened as suggested by Dr. Mees and Sheppard. The difference of colour effect is very marked, particularly in those subjects, such as landscapes, wherein there are different shades of green; these always appear dingier by a reddish or yellow light than by a white light. I hope one day to see an exhibition of Autochromes illuminated by daylight, so arranged that no light other than that coming through the picture reaches the eye. To those who have not examined an Autochrome in this way I would suggest it as an instructive experiment, for it can be easily carried out by placing the plate in the back of the camera and examining it through the lens aperture in the camera front.

Undoubtedly the transparencies are ahead of the prints, and I have already expressed my opinion generally as to the Autochromes. Turning now to the particular exhibits, the first is that by M. Meys, of Boulogne. Considering the range of subjects that M. Meys shows there is no doubt as to his mastery of the process. No. 89, a snow scene, and No. 94, "The Forge," are superb examples. The fire, and the red-hot iron on the anvil, in this last are specially noteworthy. No. 88 is interesting for comparison with No. 120. In the former there is an excellent rendering of gold picture frames, whilst in the latter this is a failure.

Herr Dührkoop's portraits have lost their individuality. Probably but few familiar with his monochrome work would be able to spot these as his work. Nos. 100 and 103 are the most pleasing, though in the rendering of plush and ermine No. 99 is excellent.

Of Mr. J. C. Warburg's work I have already probably said enough, but one cannot help drawing attention to his boldness in using softness of definition in 110 and 116. The latter is rather a clever colour scheme, the dominant note of which is the pink of almond blossom, the only blot on it being the colour of one of the sitters' arms, this being a peculiar blue-green that one might almost say was the complementary colour to the pink.

The exhibits by Mr. Gray, Dr. Powell, and Mr. Knowles call for little comment, except No. 120 by the first, which, if I am correct in assuming the cabinet to be buhl, signally fails to convey the general effect of it.

Mr. H. T. Malby has long been famous for his flower work in monochrome, and he bids fair to rival it with his Autochromes. Technically, they are excellent, and there is that careful selection and arrangement which shows the least obvious trace of selection.

Captain Stomm's exhibits, not only in the small lantern size, Nos. 134-138, but also the larger ones, 186-189, are all copies of paintings, and excellent examples. It is, of course, difficult to say exactly how true they are without actual comparison with the originals, but one or two are such well-known pictures that most can judge for themselves.

The portraits by Mrs. S. Shaw and Arthur C. Banfield are really very good examples of this particular class of work, though I prefer No. 139 of the three. The rendering of the flesh tints is exceptionally happy. Of Mr. Milburn's exhibits the grey misty effect in No. 147 is very striking, whilst No. 148 is equally as happy in a more brilliant key.

Dr. Rosenheim proves himself not only a master of the plate in landscape and still-life, but also in photo-micrography. The joint exhibit by him and Dr. Hurry is not only very fine technically, but also extremely instructive, and No. 169 is probably the largest photo-micrograph of the grain yet shown. One is rather tempted to ask how it is that these exhibits are so brilliant; they seem much more so than any photo-micrographs I have yet seen. I should like to ask whether they are cemented to the cover-glass with Canada balsam, or have undergone any special treatment.

Dr. Drake-Brockman's exhibits are also good, and No. 178 is the best. Mr. Welborne Piper's frame is, educationally, of great value, and each picture should be carefully studied.

Dyed Film Transparencies.

Dr. König's pinatype transparencies are very fine examples, as one would naturally expect, and No. 145, a portrait, very happy.

Amongst the Sanger-Shepherd transparencies it would be invidious to pick out one exhibit for special mention although one cannot omit to call particular attention to No. 206, an enlargement which is, technically and pictorially, very fine. It is curious that No. 201, by Mr. A. W. Everest, is a lantern-slide of exactly the same subject, the former being by Mr. W. V. Westlake. Mr. Butler is happier in his pre-dyed transparencies than in the print which has already been referred to.

Naturally, Sanger-Shepherd and Co. are exhibiting some excellent examples, which show what fine results can be obtained in competent hands.

Taking it on the whole, the exhibition is not only well worth a visit, but almost every exhibit will repay careful examination, as it really shows what can be done by commercial methods of colour-photography. Naturally, one must feel a little disappointment that some of the later screen processes, such as the Warner-Powrie, the Krayn, the Thames, the Omnicolore, etc., have not arrived. One may be impatient to see results on these plates about which so much has been written and promised.

E. J. Wall, F.R.P.S.

PERSULPHATE v. PERMANGANATE AS THE REVERSING SOLUTION FOR AUTOCHROMES.

[The following note on a modification in the treatment of Autochromes is by Mr. G. E. H. Rawlins, of oil-printing fame, and in other branches of photography an indefatigable experimenter.—Eds. "Colour Photography" Supplement.]

The convenience of the Autochrome process would be greatly enhanced if it were found possible to reduce the number of working solutions to less unwieldy figures than those set forth in Messrs. Lumière's instructions. That this may be satisfactorily done is proved by the fact that many successful workers now employ only rodinal (for both the first and second development) and the reversing solution, intensification being regarded as quite an exceptional resort. But owing to the unavoidable circumstance that exposure is a highly uncertain factor, it is always advisable to develop the plates, if possible, while the original subject is still available, and this is perhaps even more necessary when on tour than among familiar surroundings. The inconvenience of carrying solutions, however, renders a chemical outfit in dry, compressed form so highly desirable that the following suggestions may not come amiss.

When using the ordinary permanganate reversing solution, I had noticed that unless it were filtered before use it would occasionally deposit black specks on the film, which were at first cheerfully attributed to flaws in the manufacture of the plates, but which, upon closer examination, proved to be particles of manganese oxide, no doubt thrown down by organic matter present in the water. This led me to search for a more cleanly substitute for the "C" solution, and it seemed reasonable to expect that ammonium persulphate would answer all requirements. Experiment quickly showed this to be the case, and I have now quite discarded acid-permanganate in its favour.

In using persulphate, it will be found that the action is slower than that of the ordinary "C" solution, but it has the advantages of both portability and complete freedom from any possibility of causing spots or stains. I have used it, too, with equal success, in the ordinary crystalline form, and as prepared by Messrs. Burroughs, Wellcome, in "tabloids." For travelling purposes, of course, nothing could be more convenient than these, and as perfectly suitable developers are also obtainable in this form, the complete outfit can be reduced literally to pocket dimensions, such as would not inconvenience even the most fastidious cyclist.

To compensate for the slower action of the persulphate I use a solution of from 5 per cent. to 10 per cent. in strength. Perhaps the best method is to use two baths in succession, giving the plate about five minutes in each. As the solution is colourless, it is much easier to determine when the action is complete than is the case with permanganate. Two tabloids to the ounce of water will give a solution of 5 per cent. strength, and it is extremely easy, with these, to prepare the second bath while the plate is in the first, thus ensuring the greatest possible freshness and activity of the solution. When several plates are to be developed at a time, a little economy may be effected by using the second persulphate bath of the first plate as the first bath for the second plate, and so on. Certainly, the cost of persulphate is much greater than that of permanganate, but the advantages of portability and stainlessness more than outweigh the extra expense.

With regard to developers, I have used metol-quinol, "Rytol," and amidol in the tabloid form, and even pyro-soda, with equal success; and I prefer any of them to pyro-ammonia, which I detest.

A tabloid outfit such as I have described really renders Autochrome photography as convenient and portable as could very well be conceived, and since I can vouch for its practical success, I trust that other workers will take the hint and reap the benefit. G. E. H. Rawlins.

THE TREATMENT OF INCORRECT EXPOSURE OF AUTOCHROMES DURING DEVELOPMENT.

In an earlier communication* we pointed out the means of improving under- and over-exposed Autochrome plates, by variation either in the duration of development, the temperature of the developer, or the composition of the normal developing solution. These modifications could not be used unless one knew previously the amount of under- or over-exposure to be dealt with. They could, therefore, only be used in a few cases. In the present study we have sought a method allowing during development the amount of under- or over-exposure to be gauged, and the means of modification and improvement to be applied to incorrectly exposed plates.

Lighting the Dark-room.

To ascertain the degree of exposure of a plate, it is necessary to be able to follow the appearance of the image during development. At the outset we endeavoured to discover a method of illumination which would permit of useful examination of the plate during development without fogging. In a previous communication we indicated the marked decrease in sensitiveness shown in the different regions of the spectrum by gelatino-bromide of silver plates when immersed in water or developing solutions. This decrease of sensitiveness is particularly noticeable with panchromatic plates for yellow, orange, red, and green rays.

In the application of these experiences to Autochrome plates we found that red or yellow and green glass, chosen spectroscopically, may be used with different light sources of low intensity, and will enable the appearance of the image to be followed without fear of fogging.

As source of light, a candle, paraffin lamp, or incandescent electric lamp may be used, provided that the lantern be fitted with suitably selected red or green and yellow glasses in sufficient numbers.

The variation in depth of colour of commercial red and green glass gives insufficient security, and it is preferable to soak gelatinised glass plates in suitable dyes, or to use tissue paper similarly dyed. Our best results were obtained by the combination of a very inactinic yellow, such as tartrazine and methyl violet, these giving a red light; or, in cases where a green light is preferred, malachite green.

These two colours combined in suitable proportions, and spectroscopically tested, only allow the passage of the least actinic rays of the spectrum (infra red or green). The combination which we prefer, both from its inactinism and its high luminosity, is the green. We obtained an intensity of colour such that perfect security is assured by the combination of one yellow paper with two or three green papers according to the intensity of the source of illumination.

Choice of Developer.

The developer most suited for Autochrome plates is pyrogallic acid and ammonia, as we first recommended for use, but its rapid discoloration on exposure to the air prevents the appearance of the image being easily followed. This difficulty, however, is overcome by the addition to the developer of a very small quantity of soda sulphite. An addition of one gramme of anhydrous soda sulphite to 100 cc. of developer keeps it without discoloration during use. This addition of sulphite slightly increases the time of development.

Modifying of the Developer During Use in Order to Correct Over- or Under-Exposure.

We sought a method of development allowing variation in the composition of the developer and the time of development according to the time of the appearance of the image. We know that given the same developer at the same temperature, the time the image takes to appear is governed by the exposure.

In order easily to mark the moment of appearance of the image, and to obtain for variation of exposure sufficiently marked differences in the time of appearance of this image, we used at the outset of development only a small part (about ¼ normal) of the ammonia solution. As soon as the image appears a further quantity of ammonia is added, governed by the time taken for the image to appear, and development is continued for a further period, which is fixed by the quantity of ammonia solution used.

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* "Colour Photography" Supplement, Dec. 6, 1907, page 90.

Method of Development.

Prepare the following solutions:—

AA.—Water		100 ccs.
	Bisulphite of soda liquid (commercial)	2 drops.
	Pyrogallic acid	3 grammes.
	Potass. bromide	3 grammes.
BB.—Water		85 ccs.
	Anhydrous soda sulphite	10 grammes.
	Ammonia .920 (22 deg. Baumé)	15 ccs.

For use, dilute to ¼ strength—i.e., 50 cc. solution BB, 150 cc. water.

For a plate 13 by 18 cm. pour into the dish

Water	80 cc.
Solution AA	10 cc.
Solution BB diluted to ¼ strength	10 cc.

Temperature 60 deg. F.

and put in a small graduated measure

45 cc. of solution BB (¼ strength)

ready for addition, if necessary, wholly or in part, to the developing bath during development.

Take the plate from the dark slide, as far away from the light as possible, with back turned to the light.

Hold the plate so that the black card is kept against the sensitive coating, then rapidly immerse the plate in the dish, after having removed the black card.

When the plate is in the dish, count the number of seconds elapsing between the plate entering the dish and the appearance of the first contours of the image, disregarding the sky, if a landscape.

It is unnecessary to come near to the light under 20 seconds at least, for whatever may be the degree of over-exposure of the image, the first outlines never appear under 22 seconds.

As soon as the image has appeared, keep the plate from the light by turning your back to the lantern, and, if needed, add to the developer the remainder of solution BB kept in reserve in the small graduated measure.

Keep the dish in the shadow, and only approach the lantern from time to time to judge by reflection the appearance of the image.

Proportionately to the time of appearance of the image, varying quantities of the reserve solution BB from the graduated measure are added.

The time of development may be varied by the quantity of BB added. The quantities of solution BB and the different times of development corresponding to the time of appearance of the image are indicated in the following table:—

Time of appearance of first outlines of image, disregarding sky.	Quantity of solution BB diluted to ¼ to add after first appearance of image.	Total duration of development including time of appearance of image.	
Seconds.	Cubic Centimetres.	Minutes.	Seconds.
22 to 24	Nil.	2	—
25 to 27	2	2	15
28 to 30	8	2	30
31 to 35	15	2	30
36 to 41	20	2	30
42 to 48	25	2	30
49 to 55	30	2	45
56 to 64	35	3	—
65 to 75	40	4	—
Above 75	45	5	—

This method of development, which we have used experimentally on a large number of plates, has given us excellent results, particularly with over-exposure. With much over-exposed plates we were able to obtain results as good as with normal exposure.

A. and L. Lumiere.
A. Seyewetz.

SCREEN-PLATE PROCESSES OF COLOUR PHOTOGRAPHY.

According to an article in "La Photographie des Couleurs," still another of the competitors in methods of screen-plate one-exposure colour photography is shortly to reach a commercial stage. This is a process to be named the "diopticolore," the result of experiments by L. M. Dufay, whose work has been done in conjunction with the firm of dry-plate manufacturers, Guilleminot, Boespflug, and Co., of Paris. The process is said to be protected by patent although no specification respecting its claims has yet been made public. The process, however, is said to be based on the interposition of a microscopic mosaic filter between the image formed by the lens and the emulsion. The colour filter is said not to be formed of grains irregularly deposited, nor is it prepared by the cutting of a section from a block of coloured sheets. Equally, it has nothing in common with the so-called "omnicolore" plate of Ducos du Hauron, in which the filters are formed by varnish inks; nor, again, is it produced by printing on bichromated gelatine from ruled screens, as in the Warner-Powrie process. While we are without information as to the method which is employed for the production of the plate, we are told that the filter layer consists of a thin continuous homogeneous film of gelatine, extremely transparent and clear grey in tone. The filter elements in this screen are formed without the addition of any foreign body, such as starch grains, coloured varnish, or ink, the formation of the blue, green, and orange filters being produced by special unknown means. The process is said to allow of the pattern of the plate being made according to any design, whether of points or lines, and to permit also of a precise alignment of the various coloured elements without gaps or overlap. Our contemporary "La Photographie des Couleurs," which is edited by Mr. H. Quentin, has doubtless good reason for drawing attention to the process, which it announces is shortly to appear in the commercial stage.

We are further informed from Paris that the screens already made have patterns of circles and of squares, and are of 150-200 units per inch in fineness. They are said to be very transparent, without blocked-out interspaces. Patents for the process are in course of application.

The section-cut filter screen, which has been heard of chiefly in connection with the various patents of Robert Krayn, appears to be engaging the attention of other experimenters in Germany, and a recent patent, No. 197,749, of March 7, 1907, has been granted to the Vereinigte Kunstseidefabriken, of Kelsterback a/M. This firm has worked out a modification of the method of manufacture of the screens by which a final structure is produced. Their procedure is to build up the screen in the way adopted by Krayn, namely, by the superimposition of coloured sheets of gelatine, and then, before cutting the screen, to subject the whole block to strong pressure, by which each sheet of celluloid is squeezed to a thinner substance.

The German patent, No. 197,610, of Dr. J. H. Smith, Dr. W. Merckens, and H. B. Manissadjian for the preparation of colour-screens for photographic purposes has been published by the German Patent Office. The specification deals with the making of mosaic colour-plates by a process of intaglio printing, it being found that the methods of typographic printing are incapable of giving the necessary intensity and covering power of the colours. The following is described as an advantageous method of carrying out the process. Soft paper containing as little size as possible is coated with gum arabic, or a similar easily soluble substance, and a soft collodion film applied thereto. The colour mosaic is printed on this substratum, and is afterwards transferred to glass. The transfer to glass or other transparent support is done by squeegeeing the paper in a wet condition, and subsequently stripping it away. The screens so obtained on the transparent support were coated with a panchromatic emulsion. It is also possible to print on the so-called stripping paper, and to transfer the screens so obtained in the usual way on to a transparent support. In this case there is no special film as the carrier of the screen, and thus the difficulty that parts of the screen may separate cannot occur. The advantage of the above-described method lies in the fact that an extremely thin collodion film no thicker than 1-100 mm. can be used, and it dispenses with a special protected film between the screen and the emulsion.

AUTOCHROMES ON TOUR.

Considerable interest has been taken at various places on the Continent in the Autochromes of M. G. Courtellemont, who has recently returned from a tour in the Near East, in the course of which he has made some 1,300 pictures on Autochrome plates in Egypt, Palestine, and Turkey. Some notes in the "Photo Gazette" give particulars of M. Courtellemont's practice. He used two cameras, one carrying 9 x 12 cm. plates and the other 13 x 18. The lens was a Goerz *f*/4.6, and, as a general rule, was used at its full aperture, permitting of an exposure of one second, or less. If a smaller diaphragm was found to be needed in order to secure sharpness of several planes of the subject *f*/6 was used, and in the case of a few subjects in which there was a very near foreground the aperture was *f*/20. M. Courtellemont's collection includes transparencies of interior scenes of mosques and of museums, which are described as extremely beautiful. In regard to these, he was able to give no definite rule as to exposure. He also exhibited a number of excellent sunset pictures on Autochrome plates, in regard to which his rule for exposure was somewhat as follows:—With the sun still visible above the horizon an exposure of 4 seconds was sufficient; immediately after the disappearance of the disc of the sun 25 to 30 seconds was necessary; half an hour later the quite different aspect of the sunset required 50 to 75 seconds; and still later, when night had almost fallen, and there remained only the soft mauve light which is characteristic of the evening in Oriental countries, an exposure of 4 to 5 minutes gave an extremely true rendering of the scene on the Autochrome plate. Although it is not stated, it is presumed that the aperture used by M. Courtellemont for these exposures was *f*/4.6.

In regard to development, M. Courtellemont has made it a rule always to develop his Autochromes whilst on tour. This he has done every evening in the bedroom of the hotel, carrying the process only as far as two stages—namely, the development in the pyrogallic solution, and the reversal of the image in the permanganate. He then puts the plates aside until the next morning, when they are exposed to daylight and re-developed with diamidophenol. The intensification of the plates was postponed until he returned home. M. Courtellemont is thus strongly of the opinion that Autochrome plates may be taken by the tourist with just the same amount of satisfaction as ordinary plates are at present, as regards results. His own results of satisfactory transparencies amount to 60 per cent of the total 1,300 plates exposed.

A cricket match between the staff teams of Messrs. Houghtons Ltd. and Messrs. W. Butcher and Sons, Ltd., of Camera House, took place on May 23, at Messrs. Butchers' ground at Highams Park. The match was well contested, and there was much excellent individual play on both sides. The game resulted in a victory for the "Ensign" team (Houghtons Ltd.) by 36 runs.

THE AUTOCHROME PLATES.

Writing in "Knowledge" for May, Mr. Chapman Jones has the following facts to communicate in reference to his use of the Lumière Autochrome plates:—

"Since referring to these plates I have had some exceptional experience with them, those dealt with having been received not later than last November. A microscopic examination of three different samples showed in each case that the starch grains were distorted to a certain extent, doubtless by pressure, and that a black powder had been applied to fill up the spaces between them. In one case the black powder had stuck also on the top of the starch grains, while in the other two samples it encroached to a comparatively slight extent on the area occupied by the starch. In neither of the three cases were the interstices completely filled, but the spaces occupied by neither the starch nor the black powder formed a very small proportion of the total area. In each case the patches of colour were clearly visible to the naked eye, because of the grouping together of the red, the green, and the blue grains; indeed, it seems impossible to thoroughly mix them.

"The plates I had, though quite good at first, had deteriorated to a useless condition in a little more than three months, the sensitive layer giving spots and markings of different kinds. I exposed one on a coloured diagram, and treated it according to the full instructions of Messrs. Lumière. It proved to be under-exposed, therefore the contrast was poor and the colours were dull, and there was a deposit of silver over the whole surface. On the following day I treated it to the ordinary hypo and ferricyanide reducer until the silver was dissolved away from the white parts of the diagram. This left little more than the ghost of an image. After drying the plate I worked up this image to good density by intensifying it four times successively by the mercury and ferrous oxalate method, without intermediate drying. The whole treatment occupied about an hour and a half. This included, of course, eight washings, and each of these was of six or seven minutes' duration. The plate stood this treatment perfectly, showing no other sign of giving way than a slight frilling at the edges that did not extend beyond the part covered by the rebate of the dark slide. When dry, the loosened edge of film was scraped away and the plate varnished. The colours are good, a slightly pinkish tint of the whites being obviously due to the preponderance of red grains in the starch layer, as there is no deposit of silver in this part. This experiment shows not only to what extent these plates can be safely manipulated, but proves that the short washing recommended by Messrs. Lumière, about five minutes, is sufficient, for the repetition of the mercury and the ferrous oxalate method of intensification is a good test for the thoroughness of the washing. If the mercury salt and the ferrous oxalate, in turn, had not been thoroughly removed, the plate would have become fogged or stained. Ordinary tap water was used throughout, and this led to the usual slight deposit of calcium oxalate. Rather than running the risk of removing this by a hydrochloric acid bath, which is generally the best method to follow, I merely varnished the plate as specified by Messrs. Lumière. Deposits of calcium oxalate entirely disappear when a plate is varnished." Chapman Jones.

New Books.

"La Photographie en Couleurs sur Plaques à Filters Colorés." By E. Coustet. Paris: Bernard Tignol. Fr.2.

The literature of the screen-plate colour process grows somewhat rapidly, and the collection of books which have followed the introduction of the Lumière Autochrome plate makes quite a respectable show on our shelves. M. Coustet is rather slow in getting to his subject proper, yet even so his historical introduction is not at all a complete one. His instructions for the working of the Lumière process are those which have now become standard, or at any rate were recognised as standard during the first months of Autochrome photography. M. Coustet, in his last chapter, gives a review of the other screen-plate processes.

"Die Autochrom-Photographie und die Verwandten-Verfahren." By Dr. Ernst König. Berlin: Gustav Schmidt. M.1.20.

In this work, which forms the latest number of the "Photographische Bibliothek" of Herr Schmidt, Dr. König has provided a useful summary of the voluminous literature which has followed the introduction of the Autochrome plate. His references to original communications make the volume more deserving of preservation than other manuals of this type, which, once they have been perused, may be thrown aside. Dr. König deals briefly, but sufficiently, with the separate stages in the making of an Autochrome, but his most interesting chapter concerns the making of paper prints from Autochromes by the pinatype process, as directed by M. Léon Didier. The concluding portion of the work deals with other screen-plate processes, chiefly the Warner-Powrie, of which Dr. König predicts a great popularity as soon as they are on the market. Mr. Powrie, it is mentioned, had given the author a personal demonstration of the making of the screen-plate ("Die fertigen Rasterplatten, die unter den Augen des Verfassers von Mr. Powrie hergestellt wurden." . . .)

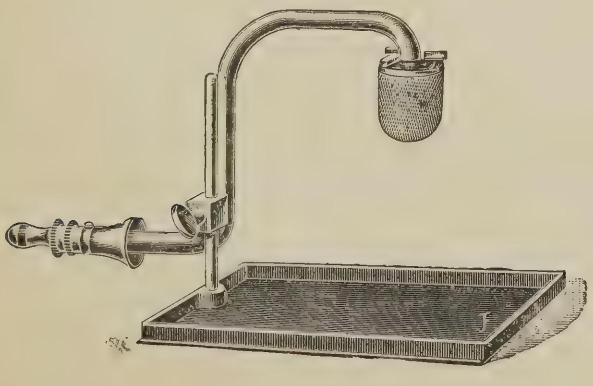
New Materials.

"L'Unichrome." Sold by Photo-Mondain, 8, Rue de la Chaussée d'Antin, Paris.

This is described as a universal developer, especially designed for use in colour photography, that is, for use with Autochrome plates, both for the first and the second development. For use, we are instructed to dilute it with one or two times its volume of water and to develop for from five to ten minutes at 18 deg. C. for normal exposures. It is claimed that the whites will remain clean even during prolonged development, and, as far as our tests go, this claim seems to be well founded. It is a clean developer that keeps well, and can be used several times over. With Autochromes its action is slow compared with that of the pyro-ammonia developer advocated by Messrs. Lumière, and we found that five minutes appeared to be about the time with a fully exposed plate, and about ten minutes with one rather under-exposed. A good washing is required after the first development and before reversal, otherwise the reversing bath is quickly reduced. Apparently "L'Unichrome" is not so readily washed out of the film as the pyro ammonia. The second development has also to be rather prolonged. We used one part of "L'Unichrome" to two parts of water in our experiments, but probably equal parts would be better for Autochrome work. It is stated that the plate can be safely examined by a special green light after one minute in the developer, and also that an excellent stand developer can be formed by diluting the stock solution with from ten to twenty volumes of water. The price of the concentrated developer is 2 fr. 50c. for a bottle of 125 grammes, that is, one of about 5 ounces.

New Apparatus, &c.

An inverted incandescent lamp convenient for the exposure of the Autochrome before redevelopment is sold by Fallowfields, 146, Charing Cross Road, price 9s. 9d.

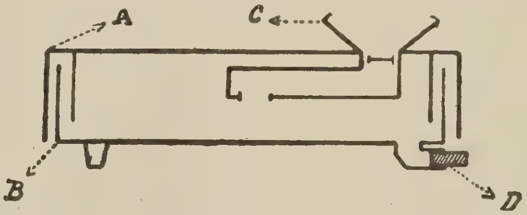


News and Notes.

Autochrome Photography.—The firm of Jonathan Fallowfield, which from the first introduction of the Autochrome plates, has shown its enterprise in assisting the Autochrome worker, has just issued an instruction book for the process, which supplements with a number of hints the makers' directions, contained in each box of plates. The writer is severe, we think, on the part taken by the photographic press in Autochrome colour photography, and certainly one or two of his own dicta, such as the statement that slight under- or over-exposure does not matter, are certainly open to question. The publication gives particulars of the accessories to Autochrome work issued by Messrs. Fallowfield, who also announce their readiness to develop and finish customers' Autochromes at a charge of 3s. to 12s. each, including mounting, spotting, and framing. They can also supply Autochromes of any article, such as pictures, etc., at the following tariff:—3¼ x 3¼, 4s. 6d.; 4¼ x 3¼, 5s. 6d.; 6½ x 4¾, 12s.; 8½ x 6½, 24s. The publication giving these and other particulars can be obtained on application to 146, Charing Cross Road, London, W.

The Autochrome in Oceanographic Research.—The assistants of the Prince of Monaco, in his Oceanographical Institute on the Mediterranean (writes a "Telegraph" correspondent), have made a valuable application of the Lumière process of colour photography. They recently showed me at Monaco coloured transparent photographs of living fishes. The fish to be photographed is placed in a small glass tank well illuminated by sunlight. Into the sea-water in the tank a few drops of chloroform are introduced, and the fish is thus rendered motionless during exposure.

Daylight Development of Autochromes.—A porcelain dish serving for the development of Autochromes has been issued in France by the firm of M. Maurice Delecaille, of Hem, Department Nord, under the name of "Marbach." A diagram shows the construction of the dish, which is made throughout in porcelain material. The cover of the dish includes a receiver to facilitate the pouring on of the developer, and a light trap around the edges to assure the safety of the plate. At the point of the margin there is a plug which is easily removable, and allows the developer or other solution being quickly discharged from the apparatus. The quantity of liquid stated to be necessary for a 9 x 12 plate is 2 oz.; 4 oz. for a plate 13 x 18 cm.



Correspondence.

⁂ *We do not undertake responsibility for the opinions expressed by our correspondents.*

⁂ *Correspondents should never write on both sides of the paper. No notice is taken of communications unless the names and addresses of the writers are given.*

AUTOCHROME PHOTOGRAPHY FOR THE TOURIST.

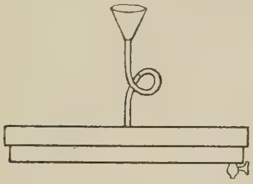
To the Editors.

Gentlemen,—I see in the "Colour Photography" supplement for May 1 a letter from "J. M. J." on the above subject, and my experiences and suggestions may be of interest.

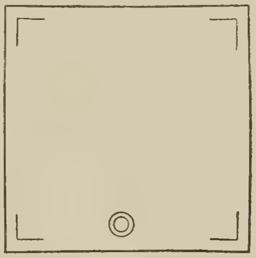
Firstly, with regard to transport of solutions. This is by no means so formidable a matter as it would appear. The two solutions necessary to carry will be the alcohol and sulphuric acid, and as the former is an innocuous medium, it may be neglected. With regard to the sulphuric acid, but small quantities of this are necessary, and can be carried in a glass-stoppered bottle in wooden case, with screw top, of the type supplied by any chemist. The other substances—*i.e.*, permanganate, amidol, sulphite, pyraxe, and citric acid—can all be carried in wide-mouthed stoppered bottles in the solid, the sulphite being in tabloid form. All these bottles may be carried in a small handbag. the sides of which have been fitted with partitions made by sewing a strip of brown holland or buckram round the interior at intervals. Such a contrivance is similar to that in small midwifery bags obtainable. The floor of the bag can be occupied with one's stock of plates, a small chemist's balance, a porcelain developing dish, glass measure, and the light-tight developing tank, and the whole made snug by the changing-bag packed round them.

With reference to the developing tank, one such as I have devised and use for all my work is very suitable. I work chiefly Autochrome plates of size 3¼in. by 3¼in., and for this I have devised a box for developing 4½in. square and ¾in. deep. Within this are four angles, which enclose a square space 3⅜in. square, and in the floor near one side of the box is a small brass tap let in and slightly sunk below the inner surface of the box.

The lid of the box fits close, and overlaps the sides for ½in. all round, and centrally placed in the lid is a copper pipe ⅜in., with a circular turn in it, and with its free end funnel-shaped. Of the box I append rough sketches. The turn in the pipe in the lid acts as a perfect light-tight joint, and when the tap beneath the box is opened after development no light seems to enter. All one has to do is to place this box and dark slide in the changing-bag and transfer the plate to the box and close down the lid. The whole can then be removed into daylight. The developer is poured into the funnel, rocking the while, and development can be timed to a nicety. When development is complete the tap beneath can be opened, the developer run off, and water poured into the funnel tube in the lid, and the plate washed free of developer in total darkness. The plate is then transferred to an ordinary developing dish. This contrivance costs but little, and is as effective as one could desire.



Elevation.



Floor of Box.

The whole box made in copper and plated only costs about 5s. at the most. Thus the whole tourist's kit should not be more cumbersome than a small handbag. Small pockets may be fitted at each end of the bag interior to take magnesium ribbon, dammar varnish, cover, glasses, and spotting colours and brush. Binding strips can be carried in a moderately wide test tube, with the bend of the doubled strips projecting from the open end, and allowing one strip to be withdrawn at a time. Distilled water need never be carried for making up solution G, as ordinary well-boiled water will do equally well.

I may mention that I used the developing-box above mentioned when demonstrating the Autochrome process before the local camera club with complete success.—I am, yours faithfully,

H. G. Drake Brockman, M.R.C.S.

County Borough Asylum, Middlesbrough

LEUCO DYES *V.* THE BLEACH-OUT PROCESS.

To the Editors.

Gentlemen,—In the "Colour Photography" Supplement for May 1 you publish a paper by Messrs. Stenger and Leiber on "The Preparation of Paper Prints from Autochrome Plates by Means of the Leuco Bases." The authors acknowledge that they have not obtained any practical results; that the few experiments they made simply did not contradict their "theoretical reasoning"; that they have not found suitable leuco bases; that they do not know what would be the best method of applying the bases if they found them; and bring forward other "theoretical" considerations *ad nauseam.*

Now, although theory often breaks down at the very point where most is expected from it, it is interesting sometimes to view subjects from a theoretical standpoint, even if the theory does precede the practice. On this account I would not have troubled you with these lines, although I think, even then, the article might have received a less pretentious title.

I do, however, object to the audacity of the authors in attacking a process (the bleach-out one) which *has* given practical results, for which suitable dyes *have* been found, and that without subsequent correction in manipulation, and where at least one satisfactory method of applying the dyes has been worked out. That absolute perfection has not yet been arrived at proves nothing. If "theoretical reasoning" could produce perfection we might have reached it long ago.

It would have been early enough for Messrs. Stenger and Leiber to attack the bleach-out process when they had by practical experiment produced a paper reproducing, say, coloured window transparencies with such a degree of faithfulness as "Uto" paper will do, without soaring to the ambitious reproduction of Autochrome plates, although even these have been very fairly reproduced on "Uto" paper. Messrs. Stenger and Leiber seem to be about as far from printing Autochrome plates on paper as the bleach-out process is from yielding direct photographs in colours in the camera.

I am at present engaged on other experiments, but I hope at no distant date to resume work on the bleach-out process and the manufacture of "Uto" paper.—Yours truly,

J. H. Smith, Ph.D., F.I.C.

60, rue de la Côte St. Thibault, Bois-Colombes,
près Paris, May 5, 1908.

AUTOCHROME PLATES IN LANDSCAPE WORK.

To the Editors.

Gentlemen,—In making Autochromes at this time of the year under a blue sky I find the results are much colder in tone than some made last September, the latter being of much more mellow colouring, both in outdoor and still-life studies. Have other workers noticed this peculiarity? Also it appears unadvisable to attempt landscapes under a bright mid-day sun, better results being obtained an hour or two before sunset. This is apart from the question of exposure. An Autochrome of an interior of a greenhouse, filled with brightly coloured flowers, lighted by bright unscreened sunlight, with shadows of sash-bars cast across the subject, showed over-exposure on the sunlit portions, and under-exposure in the parts in shade. Is there any means of overcoming this difficulty by modifying developer to secure less contrast, or is the subject beyond the latitude of the plate?

Probably by conducting development as for ordinary plates, exposed on subjects with strong contrasts, more harmonious results might be obtained; but on this question I have been unable to experiment. I appears to be a problem on which more light is needed. Perhaps some expert workers would give a few hints.—Yours faithfully,

Sudbury, Suffolk. C. F. Emery.

M. MEYS' AUTOCHROMES.

To the Editors.

Gentlemen,—In my article on M. Meys' Autochromes (a number of which I have been successful in persuading him to send to the Exhibition of Colour Photographers, at 24, Wellington Street), I referred to his method of intensification, when frequent applications of the silver bath are necessary to brighten up a fully exposed picture.

M. Meys between each intensification uses a permanganate bath, but at the moment of writing I was uncertain which was the correct one. Messrs. A. Lumière and Sons have kindly written to me that the one to use is the dilute acid permanganate bath E (composed of 20 parts of the reversing bath C to 1,000 parts of water).

By the use of this bath, between each successive intensification, the plate is kept clean, and possibly the shadows are prevented, at least to some extent, from being blocked up, which I personally have found the chief trouble with repeated intensification.

21, Pembridge Gardens, Bayswater, W. J. C. Warburg.

No. 19. Vol. II. JULY 3 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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METHODS OF DEVELOPMENT AND AFTER-TREATMENT.

[M. F. Monpillard, in a recent paper before the French Photographic Society, dealt at some length with methods which he has found advisable in taking advantage of alterations in the developer and in subsequent methods of after-treating the Autochrome positive. The following is a translation of the more essential parts of his communication.—Eds. "Colour Photography" Supplement.]

In any method of doctoring the plate during development it is necessary that the image should be examined, and for this purpose the "Invicta" screens of M. Calmels, violet and yellow superimposed, may be employed, as recommended by M. Personaz, or a safe-light may be used as follows:—Two gelatine plates are fixed, alumed, washed, and dried, and then dyed by immersing them for a few minutes, one in a solution of 1 to 2 parts per 1,000 of a violet dye, such as methyl-violet, dahlia violet, the other in a 5 parts per 1,000 solution of a yellow or orange dye, such as aurantia orange II. After rinsing off the excess of dye and drying, the plates are bound film to film with a paper binding, and a filter obtained which is quite safe for the Autochrome plates, and stands such heat as is produced in a dark-room lantern.

Development—and After.

The plate should be examined, in every case, by light falling upon it, not by that coming through it, since the latter, on account of the extreme thinness of the film, and on account also of the filter layer of coloured starch grains, gives no useful guide. After a few moments' immersion of the plate in the developer, during which time the dish is kept covered, the plate is examined, chiefly with regard to those parts which in the positive image should form the half-tone or the shadows of the subject. Here the silver bromide should remain white, or, if there are details in the shadows, the outlines of these latter should appear faintly in the case of a plate which has been properly exposed, whilst the half-tones will show grey and the high-lights of the picture strongly black. Development is continued, giving the plate a glance from time to time until this result is obtained. After a little practice there is no difficulty in thus controlling the process, and to a certain extent errors of exposure can be corrected. The plate, having been washed, is then placed in bath C, which reverses the image. This bath should be used fresh for each plate, and care taken that the silver is perfectly dissolved, which can be easily seen by examining the plate by light going through it; the pure whites or the parts corresponding to the highest tones of the picture should then be quite clear. Again a thorough wash, then treatment with a chrome alum bath if there is any fear of subsequent frilling. When the plate has been freed from all traces of rose colour, due to the permanganate, the worker can judge what can best be done with it. If there are pure whites, strong blacks, and if the colours look strong and in their relative values, the exposure has evidently been right and development correct. The plate can then be given a second development, which should be done in a very bright light and to a point when the silver bromide is completely reduced. The plate is then washed, passed through the oxidising bath, again washed, and allowed to dry.

The oxidising bath, against the dangers of which many workers have uttered warnings, should be as weak as possible, and the plate given only a momentary immersion in it. I shall have a word more to say of it directly.

Now that the Autochrome plates are much more able to withstand thorough washing, it is better—in order to reduce to the minimum the action of the bath E—to give the plate, immediately before this bath, four or five minutes in running water in order to remove the greater part of the developer in the film. After this wash, the oxidising bath is used for the shortest time, the plate rinsed and dried. Its condition at this stage depends on several factors, and its appearance and complete treatment may be considered under four headings.

A Cause of Reduction in the Fixing-Bath.

(1) The blacks and the whole scale of colours lack vigour. In this case the best course is to follow the process as laid down by MM. Lumière, very carefully controlling the intensification. The image should be frequently examined by transmitted light, and the effect of the process judged, not by comparing the various tones in the whites, but by noticing objects of the same

colour: the relative values of two neighbouring tones (in colour) form a better basis on which to decide the right moment at which to remove the plate from the intensifier. There is no need to, over-intensify if the process be stopped by the above rule. The picture will lose nothing in the fixer except that the lights will clear themselves, the tints revive slightly, retaining their relative tones.

Ample use should be made of the bath H, which should be freely used, and made fresh for each plate.

If, when the plate comes out of the fixing bath, part shows a dichroic veil, the plate should be well washed to remove all trace of bisulphite and placed again in the bath E. If the bisulphite be left in the film there will be formed, in the presence of the permanganate, a small quantity of sulphuric acid, which, combining with the silver of the image, will form a subsalt soluble in the fixing bath, and will thus lead to a general reduction of the image, a cause of failure which has been experienced by many Autochrome workers without perhaps knowing the reason.

(2) The picture may appear quite satisfactory, suggesting that any intensification would only give a heavy and over-toned appearance to the transparency. If the bath E has acted but little in consequence of ample washing, it is sufficient to transfer the picture to the fixing bath, to wash and dry. In the contrary case it is advisable before fixing to give the image a reducing bath, such as D, in order to be certain that the whole of the image consists of reduced silver. Without this precaution the image may very likely be weakened in the hypo.

In the Case of Saddened Colours.

(3) The image is somewhat too strong, the colours, although having their respective tones, are on the whole slightly saddened. This results from under-exposure, from insufficient development, or from too little alkali for the pyro. In this case we have found it well to place the plate in—

Bath C (acid potass permanganate)	5 to 6 ccs.
Water	100 ccs.

Hold the plate between the fingers while plunging it quickly into this bath, and examine it at short intervals by transmitted light. The colours, and especially the whites, will clear a little; and, as soon as the desired result is obtained, the plate should be freely washed and reduced in bath D before fixing in the hypo. Without this precaution the image would lose in fixing, and to an extent proportional to the duration of the action of the weak acid permanganate solution.

In using a much diluted permanganate bath for the Autochrome plate we have found that before there are distinct signs of the partial solution of the silver image there is a superficial alteration in the tone. From black it passes to grey, and this change is the more distinct the longer or the stronger the bath is used. We may suppose that as soon as the silver comes in contact with the weak permanganate solution, it first forms a white insoluble sub-compound, which is slowly converted into a soluble compound. The image thus treated consists of silver grain *plus* a certain proportion of sub-compound, which, being insoluble, contributes to the opacity of the image. If such a plate is put directly in the hypo, the sub-compound behaves like silver bromide—that is to say, it dissolves, and the image is weakened. If, on the other hand, we first apply a developer, the sub-salt is again reduced to metallic silver, and the image will not be weakened in the hypo.

We have dwelt at some length on this feature of the process, because it explains failures which have been previously mentioned. We should add that in the case just considered, if, after the action of the weak acid permanganate bath, we notice that the action has been pushed a little too far, the picture being a little too flat, it is sufficient after brief washing to apply the intensifier to give the desired contrast, afterwards immersing the plate in the baths H and I as usual.

Symptoms of Over-Exposure.

(4) If the plate, on being taken from the solution C, appears to have faint colours and a general washed-out appearance, it should be examined with care by weak and diffused daylight. If it is found that the whole of the colours in the subject are reproduced, although feebly, there is a chance that, in spite of the over-exposure, which is the cause of its unfavourable appearance, it can still be saved. The usual process should first be carried out—second development, oxidation, intensification, and fixing. In this particular case care should be given to see that the image undergoes no weakening in the hypo, and therefore there should be liberal washing after each bath. If the exposure has not been too excessive, intensification, if continued long enough, should be sufficient to give the necessary contrast to the tones.

On this point of intensification care should be given to the great importance of the absolute cleanliness of the dish, particularly with regard to all reducing bodies, such as diamidophenol, pyrogallic acid, etc. In order that the intensifier should work without becoming muddy too quickly, the two necessary conditions are: (1) perfect chemical cleanliness of the dish, which can be ensured by rinsing it with a little C solution followed by plain water; and (2) the proper proportion of the G solution to the F or pyro solution.

An Extra Intensifier.

It is possible that, after intensification, the tone-contrasts of the picture are still insufficient. MM. Lumière recommend in this case to carry out a second intensification. In such cases we have had no hesitation in using the mercury intensifier, a formula which has given us good results for over fifteen years in ordinary photography and has been found equally suitable for the Autochrome process, particularly as the film of the Autochrome plate is so much thinner. We ought to say that of all ordinary negatives intensified by the ordinary formula not one has suffered during fifteen years. The two solutions are:—

A.—Mercury bichloride	20 gms.	...	1 oz.
Potass. bromide	20 gms.	...	1 oz.
Water (distilled)	500 ccs.	...	25 oz.

This is the bath ordinarily used for intensification. For use with Autochromes it is diluted with 4 to 5 times its bulk of water. After treatment in the acid fixing bath the plate, after a careful washing, is placed in the above bath. As soon as the necessary intensity is obtained it is well washed in running water and then immersed in—

Potass. cyanide (pure)	10 gms.	...	160 grs.
Water (distilled)	250 ccs.	...	9 oz.
Silver nitrate	2 gms.	...	35 grs.
Water (distilled)	250 ccs.	...	9 oz.

The silver solution is poured little by little into the cyanide until a permanent precipitate is produced, which is allowed to remain for thirty minutes and the solution then filtered. In this bath the image darkens, and the plate is washed as soon as no further action is noticed. If after this washing a whitish veil is formed on the surface of the gelatine, a weak bath of acetic or hydrochloric acid will remove it, after which the plate is given a rinse in water and dried. By using this intensifying process we have been able to save plates which otherwise would have been completely useless. In the case when, after this operation, the image is too vigorous it is only necessary to place it in a weak bath of hypo in order to bring it to the desired point of density.

Hypo Solution as a Fog-Remover before Redevelopment.

(5) If the plate on removal from the bath C shows that the whites, instead of being completely transparent, are apparently

veiled with bromide of silver, and that all the colours of the subject are saddened by a general veil, the appearance is clearly indicative of considerable under-exposure, or of the use of a developer containing too much ammonia-bromide solution, or, on the other hand, of over-development.

If the general fog is very slight we can proceed with the second development, and then, after washing, use a weak permanganate bath, as already described. This latter will slowly dissolve the reduced silver fog, the image will gain in brilliance, and can then be treated as above directed, re-developed, etc. But if the general fog is considerable another method must be followed. It will be understood that an Autochrome plate is exposed in such a way that, after having passed through the glass and the film of starch grain screens, the light acts on the portions of silver bromide which are in contact with the filter screen. In the case of a very bright white portion of the subject and of sufficient exposure, the whole thickness of the emulsion film will have been acted upon by the light, and on reversal all the silver will be dissolved, and we shall therefore have the simultaneous action of the three filter elements of the screen giving us portions of pure white. But if the action of the light has been insufficient to affect the whole of the emulsion film, we shall have left, in the case of extreme under-exposure, only that part of the emulsion film which was on the upper surface of the plate. This applies to all portions of the subject, and we are thus led to see that this fog of silver bromide is formed in some way behind the image proper, which latter is, of course, in contact with the filter layer. Basing our ideas on this theory, we conceived the idea of making use of a very weak hypo bath in order to remove this deposit of silver bromide before proceeding with the second development. The solution we have used is:—

Hypo solution (20 p.c.)...... 1 to 2 ccs. ... 15 to 30 mins.
Water.............................. 100 ccs. ... 3½ oz.

On taking the plate out of solution C, and giving it thorough washing (placing it in alum solution if necessary), it is immersed in this bath. Great care is taken to watch the plate by transmitted light, using plenty of illumination, preferably a yellow or green colour. Occasionally the plate should be examined by white duffused light, but as little as possible, in order that the silver bromide may not be so much exposed as to affect its reduction in the D solution. In this weak hypo bath the whites and all the colours of the plate lighten a little. The light half-tones should be carefully watched, as they may be eaten away and destroyed by too long an action. When the result is obtained the usual process is followed out. As a rule, a plate treated in this way requires to be strongly intensified, but the relative values of the tones are retained. This method is preferable to the use of a solution of iodine followed by the hypo bath. In fact, it is then impossible to control the action of the first solution, whilst, by using the hypo bath after reversal, we can follow this action step by step and assist it at the right moment. It may be added that the experiments that we have tried with a view to reducing the density of the image on the Autochrome plate after the second development have led us to experiment with persulphate, Farmer's reducer, and ceric sulphate, none of which have given us satisfaction. We then had recourse to a weak solution of acid permanganate, or to hypo solution, and have thus saved plates which appeared to be hopeless.

F. MONPILLARD.

THE DUFAY SCREEN-PLATE PROCESS.

As mentioned in the last issue of the "Colour Photography" Supplement, considerable interest appears to have been aroused in Paris by the announcement of still another screen-plate method, due to M. L. Dufay, in association with the dry-plate house of Guilleminot Boesflug and Co. Our Paris contemporary "La Photographie des Couleurs," in a general article upon the new process, mentioned many things which it was not, but from later information it is now possible to give a general description of the much-announced Dufay process. The efforts of M. Dufay appear to have been directed towards securing, first, perfect flatness of the coloured filter surface to which the emulsion is applied, and, secondly, greater transparency of the units of the colour filter.

To anticipate in a few words, the Dufay process consists in transferring quite separately to a gelatine-coated plate the three sets of colour units, red, green, and blue-violet, in such a way that they are obtained distributed throughout the plate, without gaps or overlap, the dyes which form them being held by simple imbibition by the gelatine substratum. The way in which this result is secured is sufficiently ingenious to call for admiration, though there would appear to be one technical defect in the way of the process—namely, the preparation of the colour units in sufficient depth of intensity. In the Warner-Powrie process use is made of a mordant to secure the necessary depth of colour, and it may be doubted whether by the Dufay process, in which apparently such a procedure cannot be utilised, the necessary intensity will be obtained. The process, however, is as follows: A print is made on a bichromated gelatine plate from a grating of opaque and transparent bands. This print, after development, is dyed in a bath of suitable colouring matter, and is then inked up with greasy ink, after the manner of ordinary collotype printing. There is thus obtained in the exposed parts of the bichromated print a greasy impression, and in the non-exposed parts a, say, red colouring matter. This plate is then applied by pressure to a surface coated with plain gelatine. If the bichromate print is made on a flexible support, the gelatine-coated surface may be of glass; whereas if the bichromate print is made on a glass support, that bearing the plain gelatine should be of celluloid or similar flexible material. This to ensure perfect contact between the two surfaces. As the result of this contact the greasy ink transfers itself to the gelatine surface, whilst the dye in the interspaces penetrates into the substance of the gelatine itself. We have thus a series of lines (supposing this form of subdivision of the surface to have been adopted) covering, say, one-third the area of the plate with the red filter, whilst the remaining two-thirds is covered with opaque lines of greasy ink. Before these latter have completely dried, a varnish, incapable of affecting the ink, is applied, and when the whole plate is dry turpentine or similar solvent of the ink is applied, so that both ink and varnish are removed and the plate left with one-third of its area covered by the red filter elements protected by a varnish coating.

For the second filter elements a similar bichromate plate is prepared from the same grating, developed, and stained in the non-exposed portions with, say, the blue dye. It is inked, as before, with an opaque greasy ink, and contact made with the plate which already bears the red impressions in such a way that the blue lines cross those of the red at a right angle, or nearly so. In the same way as before a varnish is applied, and then the ink removed by turpentine or similar solvent, and the plate left with the two series of red and blue lines covering two-thirds of the total area, and each protected with a coating of varnish. There only remains one-third of the area left uncovered, and this is filled with the third (green) colouring matter by application of a gelatine film or other surface containing this third dye.

Nothing is said in the inventor's description of the process as to registering the plain gelatine plate with the two bichromate print plates with which it is brought in contact. The intention appears to be that the division of the screen-plate into broken-up areas of the three colour-filters is obtained without any registration.

THE PREPARATION OF NON-FILTER ORTHOCHROMATIC PLATES BY BATHING.

[The following communication from the photo-chemical laboratory of our Italian contemporary, "Il Progresso Fotografico," which is under the direction of Professor R. Namias, appears in the current issue of "La Photographie des Couleurs."—Eds. "Colour Photography" Supplement.]

Some years ago, in writing of certain new types of commercial orthochromatic plates, we expressed the view that for the preparation of these plates advantage might well be taken, apart from the sensitising action proper of a dye, of the property possessed by certain colouring matters of staining the gelatine film yellow. This stain would thus act as a compensating screen, and the plates might then be used in the camera without a separate light-filter. Dr. König recently* has given a formula for the sensitising of plates with erythrosine to which is added sufficient of a yellow dye to colour strongly the gelatine. His formula was:—

Distilled water	600 ccs.
Filter yellow K	5 gms.
Erythrosine	.1 gm.
Alcohol	300 ccs.

Taking this formula as the basis for my experiments, I tried the effect of the two following baths:—

1.	Water	1,000 ccs.
	Naphthol yellow	5 gms.
	Erythrosine	.1 gm.
2.	Water	1,000 ccs.
	Tartrazine	5 gms.
	Erythrosine	.1 gm.

Commercial gelatine dry plates (Capelli red label) were bathed in one or other of these baths for five minutes and dried in the dark without washing. No special precautions were taken in the drying. The plates showed a strong yellow colour, which they imparted in a marked degree to the solutions in which they were placed. In order to ascertain the effect produced on the emulsion by the bath, a series of exposures were given in the spectrograph, taking for comparison orthochromatic plates obtained with a plain solution of erythrosine and also new commercial non-screen orthochromatic plates. The results showed that the above very simple and easy method gives very interesting results. It was found that in the case of plates bathed in the above baths, Nos. 1 and 2, a clear, almost uniform spectrum was obtained with only a small minimum of sensitiveness in the green. Blue and violet act less energetically, since in these parts of the spectrum there is not the absolute white band which is obtained on ordinary (non-orthochromatic) plates, or those sensitised with erythrosine only. There is a distinct difference between the plates bathed in bath 1 and those treated in bath 2.

Camera exposures made with the plates have also shown the excellent results obtainable, the rendering of the greens being very much better.

R. Namias.

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* "B.J.," October 18, 1907, p. 786.

AUTOCHROME NOTES.

Autochromes in the Stereoscope.

It was natural to expect great things from the Autochrome plate in the way of stereoscopic slides, but these expectations have been more or less upset by the fact that the grain of the plate becomes so very prominent in the stereoscope. Some have put this down to the magnifying effect of the stereoscope lenses, but we doubt if this is responsible to anything more than a very slight extent. It is, we think, rather an effect due to stereoscopic conditions. A stereoscopic slide in half-tone gives a very similar result, and the grain becomes far more prominent in the stereoscope than it appears to be when the slide is examined in the hand. It is true that in the half-tone print we have a regular grain and in the Autochrome an irregular one, but the effect is much the same in either case. We appear to be looking at the object through a finely reticulated veil that is all in one plane. This veil appears near because it is apparently in the plane of the mount, which, in a properly mounted slide, always seems to be in advance of the objects. The apparent nearness then makes the veil appear prominent, and its reticulations or grains seem to be extra large. It is not so much a case of actual magnification as of apparent magnification produced by the effects of varying distances. Apparent size is affected to an astonishing extent by apparent distance, while the actual magnifying power of the stereoscope lenses is very small.

The Choice of a Lens for Colour Work.

Dr. L. Kleintjes points out in the current number of the "Photographische Rundschau" that many Autochrome pictures, when projected or examined in the hand, appear less transparent towards the margins. This is due to unequal illumination of the plate due to the falling off of the light transmitted by the lens. The author quotes Miethe's table, in which the quantity of light of the central axial pencil is taken as unity:—

Angle.	Light.	Angle.	Light.
0°	1.00	30°	0.56
5°	0.98	35°	0.46
10°	0.94	40°	0.34
15°	0.87	45°	0.25
20°	0.76	50°	0.17
25°	0.67	55°	0.11

For the extreme corners of a plate 9 by 12 cm. it will be seen that with a lens of 15 cm. focus the loss of illumination is 33⅓ per cent., with a 12 cm. focus lens the loss is 50 per cent., and with a 9 cm. lens it is 66⅔ per cent. These measurements suggest that wide-angle lenses should not be used for colour work. There are certain devices, such as Miethe's compensator, or Meydenbauer's star stop, which overcome the difficulty; but these increase the exposure, which is already unduly long. The best plan, therefore, is to use a lens of long focus. The focus should be at least double the shorter side of the plate. Under these conditions the loss of light at the corners of the plate would not be more than 25 per cent., which in practice is negligible. But there is another cause which is more important still in diminishing the illumination at the edges of the plate. With some lenses of large aperture and short focus the central axial pencil alone uses the full aperture of the diaphragm; the oblique rays use a part only of the aperture, so that the illumination of the image is more feeble than in the above table. The use of a small diaphragm improves matters, but at the cost of rapidity of exposure. This defect can be easily seen by removing the ground glass and placing the eye at the corner of the frame, when the aperture will take the form of a section of a convex lens. This simple device will enable any one to judge of the suitablility of a lens for Autochrome work.

Cutting Autochrome Plates.

Cutting an Autochrome plate is rather a difficult job, as the gelatine film is very apt to split irregularly if the plate be cut in the ordinary way. M. Garel, in "La Photographie des Couleurs," suggests that it is advisable—he is speaking of cutting stereoscopic pictures—to place the plate, film up, on the table, and with a sharp knife cut through the film and starch grains right down to the glass, making two such incisions about one-eighth of an inch apart. To ensure the diamond cutting exactly between the two incisions he advises using a cardboard gauge, which can be easily made with any white or Bristol board. On this should be drawn a straight horizontal line slightly longer than the longer side of the plate. Near the centre, at right-angles to it, should be drawn two lines, the distance between them being equal to the cut of the diamond. This, as a rule, varies with every diamond, but it can be very easily found for any one by placing a foot-rule or straight edge on the card, drawing a line as close as possible to the straight edge, and then, without moving the latter, drawing the diamond with fairly strong pressure over the card, when the cutting point will score the surface. To cut the Autochrome, it is then only necessary to place it film down on the white card so that the line corresponding with the cut of the diamond falls midway between the incisions through the film. If the straight edge is then placed against the other line, which will be easily seen if it is drawn longer than the width of the plate, the diamond will cut the glass in the correct place.

Sodium Hydrosulphite as a Preliminary Bath.

In a short communication to the French Photographic Society, M. Georges Le Roy advises the use of a weak bath of hydrosulphite of soda (not to be confused with hyposulphite or common hypo) as a bath to be used for the removal of its red sensitiveness from the exposed Autochrome plate. The plate, after this treatment, is washed for a short time and then developed, with no more precaution as regards the illumination of the dark-room than would be taken in the case of an ordinary plate. Hydrosulphite is a compound which is so unstable that it must be prepared at the time of use by the action of zinc filings or dust on concentrated sodium bi-sulphite solution, or filings of amalgamated aluminium may be used for preference. But, instead of going to this trouble, advantage may be taken of the compound hydrosulphites prepared in Germany for the dyeing industry. These contain dry hydrosulphite, or consist of this latter compound in conjunction with formic aldehyde (formaline). These latter are issued under such names as "hydralite," "rongalite," and "decroline." A 10 per cent. solution is employed.

Sky and Foregrounds in Autochromes.

In a paper read before the French Photographic Society recently M. Personnaz has recorded some of the expedients used by him in graduating the exposure on an Autochrome plate so as to give as much as seven times the exposure to the foreground as to the sky. He carries with him a number of black cards with one edge cut to some irregular outline. When choosing the subject he looks into the lens from a point enough to one side not to obstruct the view, and inspects the inverted image of the scene reflected in the front lens. He then chooses the card most suited to the horizon line and holds it before the lens (almost touching the hood) whilst making a "time" shutter exposure, the card being kept gently moving to avoid a sharp dividing line. While the method is practicable with lens serving for plates as small as 9 x12 cm., it cannot be used for smaller lenses, such as those of the Verascope and other pocket cameras.

As regards the development of the Autochrome, M. Personnaz prefers to add at first only one-quarter or one-third of the ammonia-bromide solution.

FORMALIN FOR OBVIATING THE FRILLING OF AUTOCHROME PLATES.

[The following notes by Mr. Alfred Stieglitz in the current issue of "Camera Work" record the experience of the writer with Autochrome plates under conditions which are exceptional in this country. The solutions used by Mr. Stieglitz had a temperature of 75 deg. F., and his remedy of formalin may therefore be recommended for use in the most trying circumstances.—EDS. "Colour Photography" Supplement.]

THOSE who have used Autochrome plates and encountered frilling know how it tries one's temper and is apt to ruin one's nerves. Undoubtedly those photographers and experimenters who conscientiously follow the Lumière instructions, that the solutions used in the development of the plates be kept at 60 deg. F., and that the washing water, too, should register a similar temperature, have but little or no trouble with frilling of plates. The professional or the amateur fortunate enough to have his own work-place can regulate temperature at will; he can follow the instructions implicitly, and in so doing save money, energy, and a sweet disposition. But how about the photographic vagabond of my type? I have no place of my own; my work is done here, and there, and everywhere. Regulating temperatures to a nicety—as the Autochromes seem to require—under such conditions is not a simple matter.

Some Hot Weather Experiments.

A few days ago, during the heated spell in May, I had a few Autochrome portraits to develop. The room in which I was to undertake the developing registered 84 deg. F., the running water 74 deg. F., and the various chemical baths 75 deg. F. There was no ice procurable, or, at least, I was too comfortable to get it. A bottle of Schering's formalin was handy, and looked very tempting; yet I remembered how Lumière advised against its use; how other authorities agreed with him; and how some of my close friends, photographic experts, were also opposed to its use with Autochrome plates. Their advice had been accepted without question, but here was an opportunity to put it to a practical test, and verify it for myself.

The following is a record of six experiments made by me. In all of them the chemicals registered a temperature of 75 deg. F., and the running water 74 deg. F.

Experiment I.—Developer, diluted, allowed to act six minutes; rinsed thirty seconds; permanaganate bath, three minutes. After the plate had been in the latter bath one minute, a tendency to frill along the edges was observed; after three minutes, frilling had spread all over the plate. Result, plate useless.

Experiment II.—Developed and rinsed as in first experiment. Permanganate bath, four minutes; after first minute plate showed signs of frilling; poured off permanganate and soaked plate in a Schering formalin solution, 5 per cent., for one minute; rinsed thirty seconds, and then continued permanganate treatment another three minutes. Rinsed one minute, and redeveloped for four minutes. Frilling showed slight signs of spreading, but plate saved. Dried in sun, temperature 125 deg.

Experiment III.—Developed in a stronger solution than in II., for only four minutes. Rinsed as usual, plate began to lift along edges. Bathed in a formalin solution, 3 per cent., for one minute, and rinsed. Permanganate bath, rinsing and redevelopment followed in the usual sequence. Plate dried in sun. Result practically perfect.

Experiment IV.—Repeated experiment made in III., and found a partial frilling during redevelopment. Some solution probably worked its way between the films after the emulsion had started to lift while in the first developing bath. Dried in the sun; frilling did not spread, but result not satisfactory owing to original frilling.

Experiment V.—Repeated Experiment III., but varnished the edges of the plate before starting development. The plate was dried in the sun, and was afterwards readily intensified and washed. The use of formalin as a hardener on ordinary plates oftentimes makes them difficult to treat chemically after they have once been dried. No frilling; result, a perfect plate.

Experiment VI.—Plate treated with a 3 per cent. formalin solution for one minute, and then rinsed before proceeding with development and the succeeding operations. Carried through intensification without intermediate drying. No signs of frilling at any stage. This plate was dried in the sun, and then soaked in water, 175 deg. F., for two minutes. The latter had no effect on it. A beautiful plate in every respect. The hot water test was made merely to see how far the tanning of the film had been accomplished.

Formalin, the Key to Success.

Although these experiments are by no means conclusive, they seem to point the way in which frilling of Autochromes may be entirely overcome. They also seem to show that with the introduction of the formalin the necessity of keeping the various chemical solutions employed in the process at a low and equal temperature will be eliminated. Furthermore, the tanning of the film will permit one to wipe its surface during the operations, and to treat it locally with ease, if necessary, besides permitting the plates to be dried by heat. Two factors to be definitely determined are, whether all emulsions will stand the formalin treatment—Autochrome emulsions still vary considerably—and whether it will be better to introduce the bath before or after the first development. Before will be a decided advantage, for it would eliminate the question of temperature from the start as far as frilling is concerned. In no experiment was the brilliancy of colour affected. The experiments recorded were made with 13 by 18 centimetre plates, emulsion number 133.

Alfred Stieglitz.

THE AUTOCHROME PLATE IN METALLOGRAPHY.

[At the recent meeting of the Iron and Steel Institute a number of Autochromes, made by Mr. E. F. Law, were shown in illustration of a paper by this gentleman on the structure of metallic alloys. The following notes from our contemporary, the "Ironmonger," show the value of such a process of direct colour photography to the metal trades.—Eds. "Colour Photography" Supplement.]

The success of the metallographical examination of a specimen depends almost exclusively on the efficiency of the means available for rendering the structure visible and for the identification of the constituent or constituents, as the case may be. It is almost of equal importance to be able to obtain permanent records of the appearance of the specimen under the microscope that may be submitted to the scrutiny of others. To effect the first of these objects a large number of etching agents are available, their value resting on their selective action—that is, when any one of them is applied to the surface of the specimen some constituent may not be attacked at all, whilst of the other constituents one may be attacked more strongly than the other or others. This selective action of the etching agent gives rise to irregularities in the surface, which become visible under the microscope and frequently to the unaided eye. Then the second object—that is, making a permanent record—is best achieved by means of photography, and, as a matter of fact, our readers are perfectly familiar with such records showing irregularities of surface from the numerous photomicrographs we have published from time to time, and from these they may have gathered that the irregularities of surface permit of classification. For instance, some are blotchy, some spotted, some striated, and so on. In fact, certain classes of surface irregularities are now known to be associated with the presence of certain constituents and to be characteristic of certain conditions; hence it is that these may be identified from the peculiar surface irregularities to which they give rise on a specially etched surface. It happens, however, that in many cases the irregularities produced by different constituents are so much alike that it is difficult to distinguish them by the eye, even with the aid of a microscope, and still more difficult to recognise them in a photograph. Hence recourse has been had to another means, and to this Mr. E. F. Law drew attention in his paper at the meeting, which dealt with "The Application of Colour Photography to Metallography." He pointed out that in order to overcome the difficulty frequently met with in the selection of a suitable etching agent, Professor Martens had suggested heating the polished specimen until a film of oxide formed on the surface, when the constituents assumed different distinctive colours. The same results may sometimes be obtained by tarnishing from exposure to the air or by heating the specimen in air containing iodine, bromide, or hydrogen sulphide. Hitherto there has been some difficulty in photographing these colours correctly, but this difficulty may now be overcome, said the author, by the use of Autochrome plates, and a photograph of a coloured film can be taken, developed, dried, and mounted as a lantern slide in less than an hour. Mr. Law demonstrated in a most agreeable manner that he had succeeded in rendering difficultly distinguishable appearances not only distinct but easily identifiable, and at the same time had made records of them that can be scrutinised by others. His mode of demonstration took the form of throwing on the screen in a darkened room slides taken from the actual colour photographs of the tarnished surfaces themselves. It was a splendid object-lesson in metallography. The structures and constituents, generally scarcely discernible, stood out in bold relief, strongly intensified by striking contrast in colour. There they were, one constituent as distinct as can be from the other. There could be seen in some slides one, or even two, different eutectics, in other slides there would be no eutectic at all. In fact, various phenomena associated with the structure of alloys were clearly disclosed to the astonished audience, who signified their appreciation by occasional but vigorous applause. But apart from the interest and importance of the display, some of the slides were really beautiful. Some looked like tiger skins, others having the appearance of designs for a rich decorative Turkey carpet.

A DIAGRAMMATIC EXPLANATION OF THE AUTOCHROME PROCESS.

When on a visit to the Croydon Camera Club last winter we saw, among other things, a series of lantern slides very clearly illustrating the various stages in the making of an Autochrome transparency. These were the work of Mr. E. A. Salt, by whom they were shown on the lantern screen to an audience which was certainly to be congratulated on having offered so clear a diagrammatic exposition of the Autochrome process. With Mr. Salt's consent these lantern slides were copied and shown in the recent exhibition of the Society of Colour Photographers. We cannot reproduce them here in colours, but we have had further copies made of them, which any of our readers can prepare as lantern slides or enlargements and appropriately colour according to the shading adopted in the figures. Throughout red is denoted by ||||, blue by ≡ and green by ⁙ The five diagrams, particularly when coloured, supply an easy means of explaining to the non-technical person the peculiar use of the additive method of colour photography in the Autochrome plate.

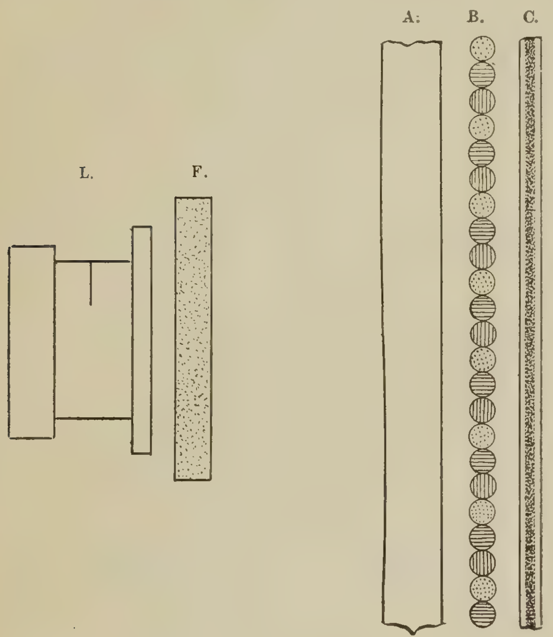


Fig. 1.

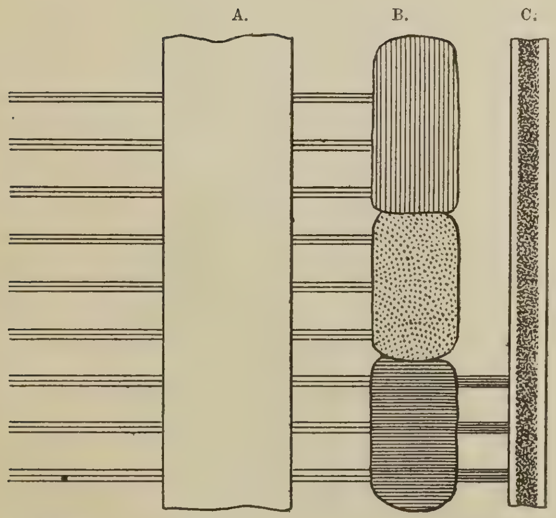


Fig. 2.

Figure 1 explains the general arrangement when making an Autochrome: L is the lens, F is the compensating filter, and A B C represent in section and on a greatly exaggerated scale the Autochrome plate ready for exposure. A is the glass, placed towards the lens, B the filter layer of coloured starch stains, and C the sensitive emulsion.

Figures 2 to 5 show the stages in the recording of a minute blue object on the Autochrome plate. What is true of the three grains shown in the diagram is true of other sets of three grains.

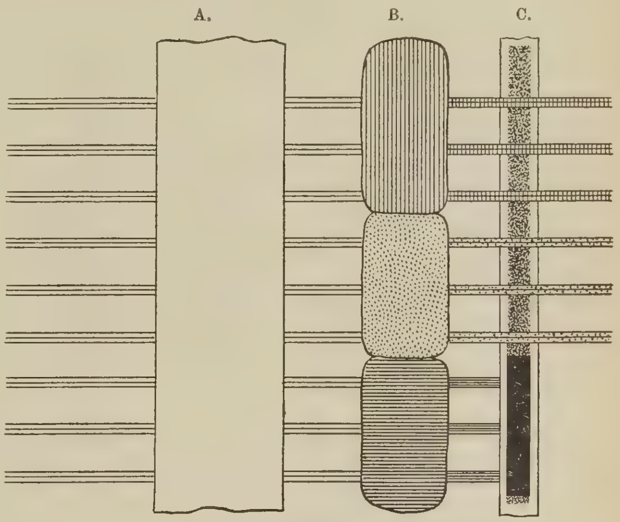


Fig. 3.

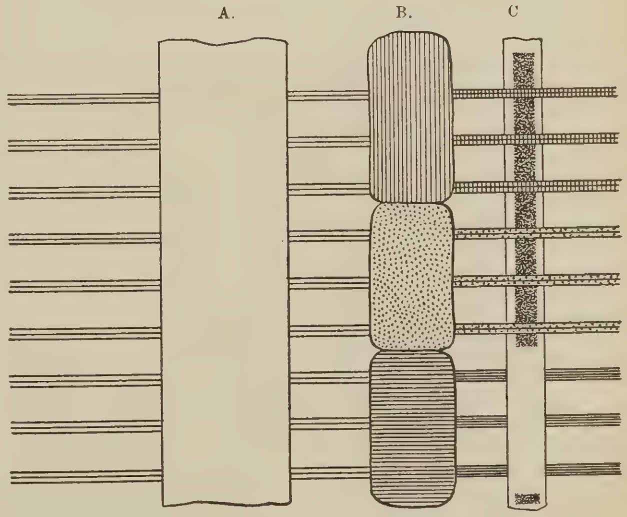


Fig. 4.

In Figure 2 is represented the state of things during exposure. The rays of light (blue) from the blue object pass through the blue grain and affect the silver image behind it, but are stopped by the red and green grains.

In Figure 3 is shown the condition of things when the Autochrome thus exposed has been developed and is examined by transmitted light. The black silver deposit under the blue grain stops out the light, whilst the red and green grains allow it to pass, and so produce the colour complementary to blue—namely, yellow. Therefore, at this stage the Autochrome appears as a negative in colours.

Figure 4 shows the change produced by reversal of the image.

The silver image under the blue grain has been dissolved out by permanganate, and the light from the blue grain therefore passes freely, whilst that from the red and green grain is partially obstructed by the emulsion film. Result, weak positive image (in colour) of the blue object.

The re-development of parts of the emulsion not exposed to light in the first instance is shown in Figure 5, and represents the final stage in the making of the Autochrome. The red and green grains are now completely covered by the silver deposit, whilst the blue grains, left uncovered, give the reproduction of the original blue object.

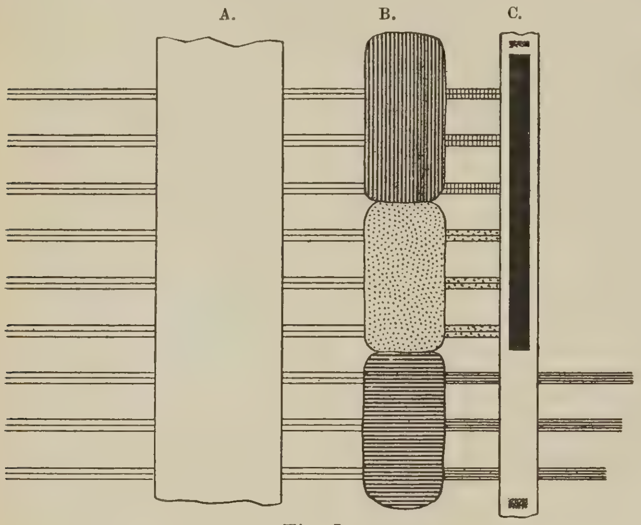


Fig. 5.

◆

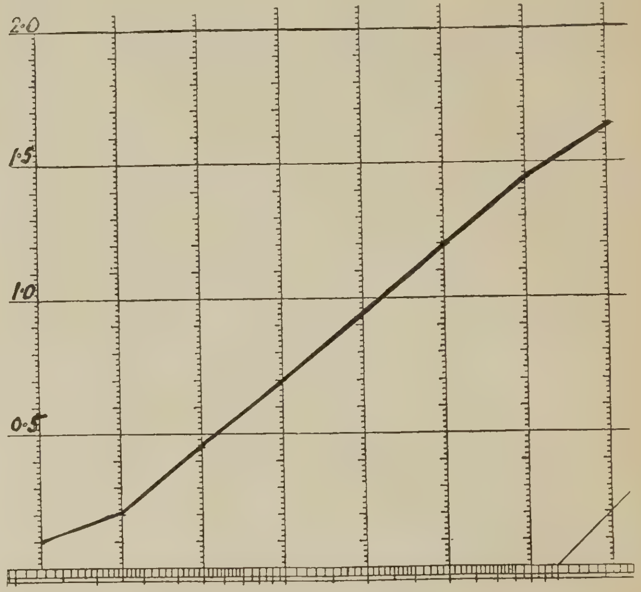
THE H. AND D. NUMBER OF THE AUTOCHROME PLATE.

In his demonstration of the Autochrome plate before the R.P.S. last November, Mr. T. K. Grant stated that in brilliant daylight he found that 14 Wynne or 2 Watkins might be taken as the speed of the Autochrome plate for outdoor exposures. A few weeks back Mr. F. Martin-Duncan wanted to make some photomicrographs on these plates, using acetylene and a Bray Elta burner, which gives a good flat flame. His first results were excellent, but on a fresh supply of plates, with a new batch number being obtained, the results were so hopelessly wrong, even on the same subject and under identical conditions, that it was thought advisable to determine the H. and D speed of the plate to the unscreened acetylene light. Naturally the colour composition of the acetylene flame, which, as Drs. Mees and Sheppard have proved, is far too rich in yellow and red to be comparable to daylight, would considerably influence the speed reading. To check this, therefore, an ordinary plate of standardised speed was exposed simultaneously and its reading reduced to the standard speed.

As only a 3¼ square plate was used, only eight sectors could be included, but they were quite enough to show that the speed of the particular batch of Autochrome plates could be taken as 2 H. and D. This was afterwards found to be quite correct by Mr. Martin-Duncan, as he made exposures on an ordinary plate of known speed, and thus found the actual exposure, assuming the reading I found to be correct.

The Autochrome plate was exposed, of course, through the starch grains, the image being a deep green, increasing in the higher sectors to a dirty greenish black. Examination with a microscope also showed that in the higher sectors there was action under all three starch grains, though rather less under the red than the blue and green.

The developer used was metol and hydroquinone, the time of development three minutes at 65 degrees Fahr., and the development factor 0.8. To determine the actual fog in the emulsion, part of the gelatine film was dissolved off the negative and this part read in the photometer, and the actual fog was .05 and the reading of the starch grains and glass .90. The actual densities were 1.65, 1.45, 1.20, .95, .70, .45, .20, .10, and these charted give the accompanying characteristic curve.



This speed determination naturally only applies to the particular conditions enumerated, but it agrees fairly well with Mr. Grant's valuation, which was practically 1.3 H. and D.

E. J. Wall, F.R.P.S.

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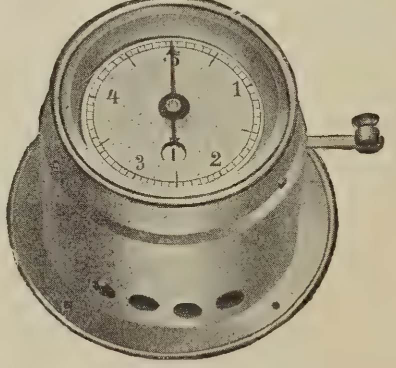
New Materials.

The Ensign Clock for Autochrome Development. Sold by Houghtons Ltd., 88-89, High Holborn, London, W.C.

A most convenient clock for use in the dark-room when developing "Autochrome" plates has been placed on the market by Messrs. Houghtons. Its adjustments will be appreciated by anyone who has had the briefest experience of being obliged to time the development of Autochrome plates in the dim green light which must be used if any light at all is tolerated in the dark-room. The "Ensign" clock contains a 5-minute dial, divided into minutes. Pressure on the lever shown in the drawing on the right winds the clock, and starts the pointer. There is but this one movement. At the expiration of two and a half minutes, the standard time of development for the Lumière original developer, a gong is sounded, and again at the conclusion of another two and a half minutes, five in all. The graduation of the dial allows of the clock being used for timing other operations where a sufficient light can be employed, and on account of its most convenient starting action it should find favour on many occasions. The clock is supplied with screws complete for attaching it in any suitable position. Its price is 8s. 6d.



No. 20. Vol. II. AUGUST 7. 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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THE NEW LUMIÈRE SCREEN-PLATE.

[The following is the description, given in the recently granted French patent, of the method devised by the Lumière Brothers for the manufacture of a screen-plate of definite predetermined structure.]

The process which is the object of the following invention is based on the successive application by imbibition to the surface of the screen of suitable dyeing colours. The process provides for the protection of one or several colours by a special varnish, one colour thus being protected by varnish before another is put on. The diagrams represent a portion of the screen in various stages of manufacture, these representing the making of a three-colour screen, although the process is equally applicable to screens containing a larger number of colours. The transparent support of glass, film, etc., is given a thin coating of gelatine or other suitable substance, and is then passed through the following stages of treatment: —

(1) Two-thirds of the surface of the plate is covered with a greasy ink, which serves only as a temporary resist, and may therefore be of any colour. This application can be made in the form of lines, points, or grains. Fig. 1 shows this first ink coating in the form of equidistant lines *a a*, indicated by cross hatching.

(2) The portion of the surface not protected by the lines is dyed with a suitable solution of colouring matter, violet, for instance.

(3) The whole surface is then varnished with a preparation which must fulfil the two following conditions:—(a) The solvent employed in making it must not dissolve the greasy ink before mentioned. (b) The resin or other substance which forms the basis of the varnish must be insoluble in liquids which dissolve the greasy ink—that is to say, if the ink employed contains linseed oil, and the varnish is made of resin previously extracted by ether and dissolved in alcohol, the solvent of the varnish, alcohol, will not dissolve the greasy ink, and after it has evaporated will leave the whole surface covered with a thin film of resin. This film, in the parts where it is in contact with the greasy ink, tends to mix with the latter on gentle heating.

If the plate is next treated with a solvent of the ink in which the varnish base itself is insoluble—that is to say, with sulphuric ether—a slight friction will remove all the ink as well as the resin which covers it, and will leave on the surface of the plate only the resinous lines covering the parts which have been dyed violet. The structure of the plate at this stage is shown in Fig. 1, where *w w* represent the series of violet lines covered with varnish, and *a a a* the portions of the unaltered plate from which the ink has been removed.

(4) A second application of ink is now made over half the total surface, say, in the form of the horizontal lines *b* shown in Fig. 2, or in any other way. The plate is then stained green, this dye in the present case being absorbed in the rectangular spaces marked *v v v*, being prevented from reaching any other part of the plate by the lines of ink on the one hand, and the lines of varnish on the other.

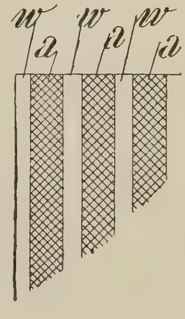


Fig. 1.

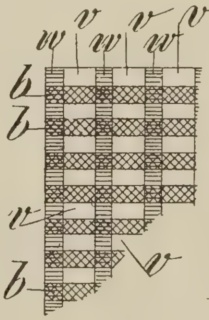


Fig. 2.

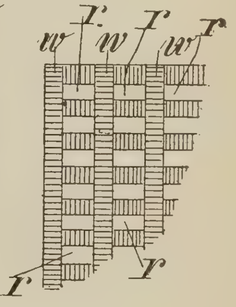


Fig. 3.

(5) The whole surface is again varnished, the solvent again applied, and the ink removed as already described in (3). We then have, as shown in Fig. 3, one-third of the surface coloured violet indicated by the horizontal hatching, and another third coloured green as indicated by the vertical hatching, the remaining third of the area of the plate being uncovered. The coloured surface being protected by a varnish, the whole plate can now be dyed in the red colouring matter, and it is then complete.

(6) The whole surface of the plate is then washed by means of a solvent of the varnished base, such as alcohol, and a pro-

tective film of rubber then applied in order to prepare the plate for the application of the sensitive emulsion.

Figs. 4, 5, and 6 show other forms in which the colours may be distributed over the plate.

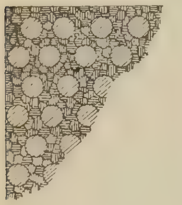


Fig. 4.

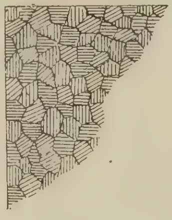


Fig. 5.

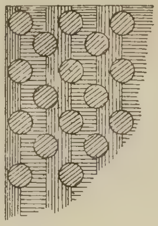


Fig. 6.

In Fig. 4 one of the colours is applied in the form of circles or rectangular polygons covering one-third of the surface; the two other thirds are covered with a grain which is equally divided between the two colours.

In Fig. 5 the three colours are divided equally, one-third each, in a grain which colours the whole surface. One can also combine these different forms, as in Fig. 6, where the vertical lines, as shown in Fig. 3, are combined with the circles and the grain of Fig. 4. By repeating for any given number of times the application of the ink resist, in each case following it by the process above described, a screen of any number of colours may be obtained. In short, the invention consists in a process of preparing polychromatic screens for direct colour photography as follows:—Each successive fraction of the surface of the screen is dyed with a different colour, whilst the rest of the surface is protected partly by an application of ink and partly by a varnish covering the colour or colours previously applied. This varnishing is rendered possible by the choice of the constituents of the varnish, which must be such that the solvent of the resin employed does not dissolve the ink, whilst the resin is insoluble in a solvent of this ink.

THE CONSTRUCTION OF ONE-EXPOSURE CAMERAS FOR THREE-COLOUR PHOTOGRAPHY.

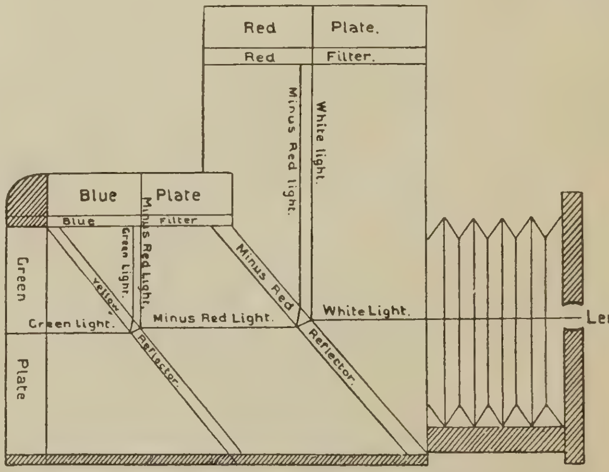
[A lecture recently given at short notice before the Royal Photographic Society on this subject by Dr. C. E. K. Mees dealt particularly with the camera devised by Mr. E. T. Butler, but his account of the measures taken to adjust the optical conditions in such an apparatus are of such general interest that we may reprint the report of his paper, together with an abstract of his replies to questions put to him in the discussion which followed.—EDS. "Colour Photography" Supplement.]

THE camera is a reflector instrument, made on the principle of Ives' "Kromskop," and is a very practical one for its purpose. I do not like repeating backs, and the necessity for giving, say, three seconds for each exposure and wasting two seconds each time in changing the plate, entails manifest inconveniences. Such a procedure makes all subjects except still life and portraiture—and the latter only under exceptional conditions—out of the question. With a one-exposure three-colour camera, if the objects move during exposure, they at least move evenly in all three pictures. Various attempts have been made to bring out a one-exposure camera, and Sir William Abney and Mr. Sanger Shepherd, among others, have produced cameras that have worked in a practical manner. This of Mr. Butler's is a good camera and works well, but it has certain incidental defects and difficulties, which I have set myself as far as possible to eliminate.

The camera takes a 6¼ in. lens. I put in a Ross Cabinet lens of 6 in. focus, and this I altered so that it is really a 7 in. lens. It works at about $f/4$, and gives very short exposures at full aperture. The camera has two transparent reflectors. The image-forming beam of light comes in through the lens, and part of it travels through a sheet-glass reflector fixed at 45 deg. to the axis of the lens. The light that is reflected passes to the first plate through a filter, and the light which passes through the first reflector meets a second reflector placed parallel to the first. In this case again the reflected part passes to the second plate by way of another filter, while the rest of the light—the direct beam—goes onwards to the third plate behind the second reflector.

Practical Requirements in One-exposure Three-colour Photography.

Let us consider the problem that we have to face in this camera. In three-colour work it is necessary to use red, green, and blue or blue-violet filters. We have in this case to take the three pictures at one and the same time, the images must be of identical size, and the reflectors must be so made that they will not give two images. A second refracted beam parallel to the first will certainly give a double image, and therefore the reflectors must be so constructed as to make that second beam of no importance. Furthermore, all the images have to be in focus at the same time. Also, if we photograph a black and white object it must be rendered of the same depth in all three negatives, that is, the ratio of exposure must be the same, and it is precisely this ratio of exposure that is the difficulty with this camera. The three beams being of unequal strength, it is usual, in order to get the fastest results, to use a plate which is as sensitive as possible to the red for the red exposure, to the violet for the violet, and to the green for the green. For instance, one might use a pinacyanol-bathed plate for the red, thereby obtaining the shortest red exposure, for the green a pinachrome-bathed plate, and for the blue a slowish ordinary plate. All users of this camera get wrong in this respect. They may have the finest red-sensitive plate, the finest green-sensitive plate, and an ordinary plate for the blue, but there are no



means of altering the ratio of exposures. With a repeating back the three exposures themselves can be altered as required, but with a one-exposure camera nothing of that kind can be done. The ratio is fixed by the filters, and if sensitiveness of the plates varies it is practically impossible to make adjustment for it. It is necessary, therefore, to find some method of arranging the camera so that this objection shall not stop us. I decided first of all that I must use one plate for the three exposures, and if possible a plate bathed in only one sensitiser. If bathed in a single sensitiser the ratios are perpetually constant. Having decided this, we will consider the conditions which we must fulfil. I have adopted Mr. Butler's plan of making the reflectors of a colour which is complementary in each case to the colour of the filter below them. Thus if we have a red reflector the filter which receives the reflected light must be minus-red. If for the first reflected beam we use a red filter we must have a minus-red, or greenish-blue reflector, and if we use a blue filter for the second reflected beam we must have a minus-blue, or yellow, second reflector. Therefore in this camera I have made the first reflector, which reflects the image of the red-sensation negative, a greenish-blue, and the second reflector, which reflects the image of the blue-sensation negative, a yellow. The minus-red filter will absorb the whole of the red, and the back beam going up after the reflection is blue or minus-red, and as it cannot pass through the red filter it makes no impression on the plate and can be disregarded.

The Most Advisable Arrangement of Filters and Reflectors.

The ends we have in view are, firstly, to use but one plate, and, secondly, to make our total exposure as short as possible. We have, therefore, to consider what arrangement of reflectors and filters will give us the desired result. The beam that goes straight through from the lens, owing to the fact that it has no reflections, will be the strongest. Consequently we shall not place the blue filter in its path, but either the red or the green. We must keep the blue for the negative that requires the longest exposure. That restricts us to one or two arrangements with regard to this direct beam; it must be either red or green. The second question is, what shall be the colour of the second strongest filter—the one to be placed at the focus of the image reflected from the first reflector? This will have the reflection of the undiminished light falling upon it. Consequently it will be wise to make it the other colour of the two—i.e., red or green. If the direct beam is red this must be green, and if green this must be red. Then the colour of the third filter, at the point of reflection from the second reflector, will be blue. Now, the question arises as to whether I shall have red or green for the colour of the direct beam. A red filter can be made which lets very nearly all the red through, but all green filters absorb some of the green. Therefore the greatest difficulty in three-colour work is to get the green exposure short. Accordingly the best thing to do is to let the green go straight through. The second place will then be taken by the red. This, then, will be the most economical arrangement of our filters, but it is necessary, inasmuch as we shall let a great deal of light through on the green-screened plate, to get a strong red exposure. The difficulty now is to obtain sufficient red. For that reason, I have taken pinacyanol-bathed plates. They are not very sensitive to green, but then, as I say, I can get plenty of green light. In this fashion I can get about the right ratio without any difficulty at all, the ordinary standard filters giving me what I require. Pinacyanol is a sensitiser which only to a very slight extent depresses the sensitiveness of the plates, and it does not vary in nature so much as other sensitisers such as pinachrome. The first of these advantages makes it possible to use fairly fast plates, and the second ensures that the plates vary in their ratio of colour sensitiveness very little.

Optical Conditions for Images of Equal Size.

The next question relates to securing images of identical size. We can obtain equal focus by altering the position of the reflectors. If we raise them we shall shorten the central beam of light. We must adjust them separately into position so that the focus of these two reflected images is the same, and when that is the case it means that the total optical path is the same. In order that the size of the images shall be identical not only the optical paths but also the path in glass must be equal.

For this purpose the thickness of the filters must be adjusted so that the length of glass through which each beam travels is equal. The length of the glass through which the direct beam travels is equal to the thickness of the two reflectors taken at an angle of 45 deg. to the axis of the lens. That is to say, it is 1.41 times the actual thickness of the reflectors. The thickness of the red filter is therefore equal to 1.41 times the thickness of the two reflectors, while the thickness of the blue filter will be 1.41 times the thickness of the yellow reflector.

In order to adjust the colour of the filters so that the correct ratio is obtained, I put pieces of film between the glasses and photographed a black and white chart, altering the depth of the film until I got equal exposures on the three filters. The films were then cemented in the glass, and the positions of the filters adjusted until all three images were in focus at the same time. If the work is properly done, I think that this single exposure camera presents us with the best method as yet available of making three-colour records. C. E. Kenneth Mees.

* * * * *

Replying to questions, Dr. Mees said that it was a fact that in the camera as Mr. Butler had arranged it, the red negative—i.e., the green printing negative—and the blue or yellow printing negative, were reversed according to the ordinary way of looking at the negative, while the green, or red printing negative, was in the usual position. Two were as positives and one was reversed.

As to whether the size of the plate to be used in this camera was limited in any way, Dr. Mees said that with due modifications of the reflector, a plate of any size might be used. With a half-plate a 7½ in. reflector would be required.

As to the glass employed for the filters, Dr. Mees said that it was essential that it should be of good quality and that care should be exercised in its selection. The glass was known in the trade as "optical plate."

Pinacyanol-bathed plates did not vary very much in ratio, but they varied in speed. This did not greatly matter, but if three different plates were used and one of them varied in speed it upset the arrangements altogether. In his opinion, the chief cause of variation in bathed plates was not due to the plates but to the dyes, which differed in crystalline form, in solubility, and in many ways.

Dr. Mees stated that he did not use a micrometer in order to obtain images of the same size: he photographed a black and white chart, and put it over one piece of glass after another. If the filters were made correctly the images would be identical in size.

With regard to inequalities in the cemented filters, it was pointed out that in the case of the filters which had been handed round the yellow and the red all showed two images. Dr. Mees said that the two images were usually a sign of the badness of the filters. A good deal depended, however, upon the length of time that the filters had been cemented. Some of the filters shown had been cemented three days and others a week. At first they showed distortion, but in most cases the distortion did not persist. The plan he employed in testing the glass was to get a piece of black paper and cut it into segments, the clear spaces between each segment forming a kind of star. He then bound them up like a lantern slide, put them in the enlarging camera, held the glass at about 45 deg., and looked for the double image. Ordinary thin parallel plate gave two images separated from each other. This was due to the fact that the glass was not really parallel but wedge-shaped. A slight appearance of opening and shutting did not matter, but if the effect were very marked over the surface it proved the glass to be bad. In the case of newly made filters this open and shut effect was almost always apparent, owing to strain. It generally disappeared in the course of a week or a fortnight, the glass seeming to recover from the strain as the balsam distributed itself more evenly.

SULPHIDE TONING IN AUTOCHROME WORK.

[In a recent paper in the "Photo-Revue," a French worker of the Autochrome process, M. Paul Torchon, recommends still another modification in the Lumière instructions. M. Torchon dispenses with fixation and intensification. After reversal he alums and treats the residual silver bromide image with sulphide solution.—Eds. "Colour Photography" Supplement.]

In the present method of development only four operations are performed:—

Development. Aluming.
Reversal. Sulphiding.

For development the standard pyro-ammonia developer of Lumière is used.

The reversing mixture is made up at the time of use from the two following stock solutions:—

A. Potass. permanganate	2 gms.	30 grs.
Water	1,000 ccs.	35 oz.
B. Sulphuric acid	10 ,,	1 oz.
Water	100 ,,	10 oz.

For a half-plate 3½ ozs. of A is mixed with ¼ oz. of B. The mixed solution rapidly changes, giving rise to permanganic acid, which may exert an action on the gelatine.

The alum bath is made up as follows:—

Alum	2 gms.	30 grs.
Bisulphite solution	5 ccs.	80 minims.
Water	200 ,,	7 oz.

The alum hardens the gelatine solution and removes the risk of frilling; the bisulphite reduces all the permanganate left in the plate after reversal. After two minutes in this bath the plate is transparent and the image pure white.

The sulphiding bath is made up as follows:—

Ammonium sulphide	5 ccs.	80 minims.
Water	100 ,,	7 oz.

After a short wash the plate is placed in this solution, where the image is converted into silver sulphide and assumes an intense black colour, the picture making its appearance in its natural colours.

The special object of adding the bisulphite to the alum bath is to make sure that every trace of permanganate from the reversing solution is destroyed, otherwise the formation of manganese sulphide in the film on treatment with the sulphide solution would inevitably lead to trouble.

In the sulphiding process the silver bromide is converted into silver sulphide: the thickness of the film remains the same, only the composition of the salt is changed. It may be assumed that the colours, therefore, are those in the subject itself, the stencil-like deposit of silver being exactly that formed by the lens. There is no "sulphuration" of the film to be feared in the use of the sulphide. No by-product is formed, and the result thus gains in purity and transparency.

There is no need, when adopting the foregoing process, to intensify the plate: the colours are brilliant, and retain the values present in the subject.

One great advantage of the process is that there is no need to fix the plate in hypo, all the silver in the film having been converted into sulphide. The only necessary precaution is to keep the sulphide solution, or, rather, the vapour which escapes from it, away from any stock of sensitive plates, films, or papers.

The method having proved most satisfactory in regular use, it is hoped that its simplicity and certainty will be appreciated by other users of the Autochrome plates.

Paul Torchon.

EXPERIMENTS WITH THE LIPPMANN COLOUR PHOTOGRAPH.

[Abstract of a Paper presented at the Washington meeting of the Physical Society.]

The colours in this process are due to reflection from laminæ of silver deposited in the loops of the standing wave system formed by reflection of the incident light by a mercury surface in contact with the transparent photographic film. Theoretically the purity of the reflected colours should increase with the thickness of the film. In practice very thin films are used, because the laminæ are formed to but a short distance, and the absorption of light by them makes but few effective. The reflected colours are far from pure. The necessity for using a mercury trough has always been a disadvantage of the process. The colours of natural objects have been difficult of reproduction because the standing wave system is shallow and unduly subject to errors of exposure and development.

The present experiments show that the non-formation of laminæ at a distance from the surface of the film is due to the kind of developer ordinarily used, pyrogallic acid. This is brought out by sections made of the films, which, wetted so as to swell, are examined with the microscope. It is found that the photographic action extends through the thickest films practicable to flow. By using other developers, such as hydroquinone, even action throughout the film results. If the developed image is then bleached with mercuric chloride a transparent deposit is obtained, and the reflected light consists of a spectrum band of only a few A.U. in width, the purity increasing with thickness of film.

A substitute for the mercury mirror has been found. Celluloid varnish is flowed on silvered glass; on drying, the celluloid and silver strip off together. This flexible mirror is then laid on a wet Lippmann film and set to dry. Exposure is made as with dry plates, the celluloid stripped off, and film developed.

Because of the difficulty experienced in securing photographs of natural objects, an application of the process to three-colour photography was tried. For this fairly pure spectrum colours are needed, and the Lippmann film is eminently fitted to give them. Pictures are made similar to the Joly picture—alternating lines of red, green, and blue, secured by successive exposure behind a line-screen to monochromatic lights.

Herbert E. Ives.

AUTOCHROMES FROM AUTOCHROMES.

In a recent paper before the French Photographic Society some notes on the reproduction of one Autochrome from another were communicated by M. L. Gimpel, whose conclusions agree with those of workers in this country, such as Mr. Welborne Piper, that it is not possible to make a reproduction which is identical in transparency, brilliancy, and purity of colour with the original, although it may sometimes be practicable to make a reproduction which is an improvement on a faulty original Autochrome.

To quote M. Gimpel: Some workers have obtained interesting copies by using artificial light. M. Gervais-Courtellemont has thus employed the light reflected by white cardboard illuminated by two arc lamps, but the average worker will prefer to employ daylight, and I may therefore briefly describe my own procedure. The Autochrome is backed with ground glass and placed in a camera of the double daylight enlarging type, or in default of this a pair of cameras may be used. The apparatus is directed towards a clear sky, which should be uniformly covered with light clouds. The lens, of course, is fitted with the Lumière yellow screen. Under these circumstances it is found that there is a slight excess of yellow in the reproduction, indicating that the screen used for making Autochromes direct is a little too deep when making copies. This defect, however, can be easily got over by combining with the yellow screen a thin violet light filter which may be made by slightly dyeing a fixed and washed lantern plate in a weak bath of aniline violet.

As has been demonstrated to us by M. Monpillard, a negative unreversed Autochrome may be used to give a positive copy, in making which, also, the reversing operation is not necessary. In this case the violet compensating screen must be replaced by a supplementary yellow screen of about the same value as the violet light filter used when making a positive from a positive. However, this process is not as advisable as the former, since to obtain two positives three Autochrome plates must be used.

The best results are obtained by reduction from a larger size. Enlargement, on the other hand, leads to weakening of the colours and exaggeration of the grain. One conclusion from such work is that reproduction of one Autochrome from another is not a method to be adopted in regular work, although in certain cases it may be useful to be able to duplicate a much-prized exposure. One can understand M. Gervais-Courtellemont wishing to duplicate some of his excellent Autochromes made in the East, for fear that the originals might be broken.

As regards the time of exposure, an example may be given. It was found that fifteen minutes at $f/4.8$ were required for a copy of the same size made in the morning of a June day in fine weather with a uniformly cloudy sky. This represents a fair degree of over-exposure —an advisable procedure when working, as I do, by inspection under the green Virida light of the Lumière Company when developing the plate.

Having experienced some difficulty in closely watching the time of appearance of the first outline of the picture and at the same time watching the seconds' hand of a clock, the idea occurred to me to employ a phonograph for counting seconds. Fitting my phonograph with an unused cylinder and registering diaphragm, I spoke into it as follows: Development of Autochrome plates. Attention (pausing here a second). One . . . two . . . three . . . up to 240, beyond which point the size of the phonograph cylinder would not allow me to go.

Everything being in readiness for development, the dark-slide is unloaded, the plate is held with its back to the dark-room lamp, and the phonograph released. Whilst the first words are being reproduced by it the plate is held ready for insertion in the developer, and at the conclusion of the last syllable of the word "Attention," is immersed. It is then quite an easy matter to give all attention to the appearance of the image whilst the phonograph is audibly counting the seconds. Those who may wish to adopt this method should make a note of the necessity of adjusting the speed of the phonograph after the record has been made. The resistance offered by the recording diaphragm slows down the mechanism to a quite appreciable extent, and the time of one second noted after the record has been made will often be found to be appreciably less if the adjustment is omitted. However, this can be easily done, and the timing will not vary a second in four or five minutes. L. Gimpel.

SUGGESTED CATALYTIC METHODS OF SCREEN-PLATE COLOUR PHOTOGRAPHY.

[The following paper from a recent issue of the "Chemiker Zeitung," is written by one with an evident acquaintance with what has been accomplished of late in direct one-exposure colour photography, yet in translating the German original we are frequently in doubt as to whether the author, in giving what reads as descriptions of practicable processes, is really doing more than suggesting possibilities. The reader will discover instances where a process, apparently described as feasible, certainly requires other materials than exist at present. We take it that the author's intention is largely to direct attention to methods which may become practicable.—Eds. "Colour Photography" Supplement.]

The first conditions which a practical process of colour photography must fulfil is that it shall utilise the bromide of silver (that is, the most light-sensitive substance) and that it shall produce pictures in pigmentary colours. Thus, all methods which depend on interference, refraction, or prismatic dispersion of light, or on simple bleaching-out are excluded. The process first described by the author in his Austrian patent specification of 1905 is based on the consideration that a workable method of colour photography is thinkable only if the grains of silver bromide in the taking plate receive a different influence, both qualitatively and quantitatively, from the rays proceeding from the coloured object, and that these differences (which should be a property of the plate) should be convertible into the corresponding pigmentary colours in a ready manner. The reproduction of the quantity and intensity of the coloured rays falling on the silver bromide presents no difficulties, and is directly proportional to the strength of the light, but in regard to the reproduction of the quality or kind of the light, there are two distinct cases to be distinguished:—In the first, the silver bromide can possess a much greater sensitiveness for rays of a certain wave-length than for others which fall upon it under the same conditions; and secondly, a screening action on the sensitised silver bromide may be introduced so that a ray of only certain colours can pass the light-filter and exert an action corresponding to its intensity.

Considering the first of these two processes, silver bromide, like most colourless or slightly coloured bodies, is an excellent absorbent of rays of short wave-length. It is, of course, well known that for a ray of light to exert an action, chemical or physical, on a body it (the body) must absorb it. The increase in molecular energy due to the annulment of the wave motion of the light supplies the explanation of the phenomena. If, between the molecules of a body which is not able to absorb rays of light of given wave-length, we interpose another body which is capable of converting the kinetic energy of the incident rays into molecular vibrations, it may be assumed that a part of the increase of strength obtained from the latter body comes also to the former. The optical extra-sensitising of silver bromide arises from the interposition of molecules of dye in this way, and it should be noticed that the colour of the compound of silver bromide and dye must usually be complementary to that of the light-ray to be absorbed. The dyeing of the gelatine itself by a dye is also of service in forming a screen within the plate itself.

The basis of the process to be here described consists in the preparation of a mixture of grains of silver bromide, each showing a maximum of absorption for the blue-violet, orange, and green, respectively. This is obtained either by dyeing the silver bromide with complementary sensitisers (that is yellow, blue-green, and purple), preferably in alcoholic solution, followed by thorough washing in warm water, or by the addition of these dyes to separate lots of emulsion, where they exert a strong dyeing action on the silver bromide, but can easily be washed out of the solidified emulsion. The three differently sensitised portions of silver bromide have then to be mixed together with the aid of gelatine solution in order to give a surface which, when spread upon glass or paper, is a neutral grey colour.

If such a dry plate is exposed under a screen which cuts off the rays of short wave length, that is to say an orange filter, each grain of silver bromide, if not exposed too long, will be acted upon by that portion of the spectrum to which it possesses the maximum of sensitiveness. The negative obtained by development and fixing is then to be converted into an image in complementary colours, which may be conveniently done in the following way:—The negative is laid for a short time in a strong solution of ammonium bichromate, which substance the finely divided silver, in consequence of its catalytic activity, reduces to chromium oxide, which in turn renders insoluble a quantity of gelatine proportional to the metallic silver present in different parts of the plate. As an appreciable diffusion of aqueous liquid takes place in the tanned portions, it is possible, by removing the dye from the unhardened parts of the gelatine, to obtain a difference between the places affected and unaffected by the coloured rays.

After removal of the silver and bichromate the image is converted, by printing, into one of the correct colours. The method may be explained by the following example:—An orange ray of light falling on the plate is absorbed by the blue-green particles of silver bromide lying on the surface, which, during development are reduced more or less completely to the metallic state. On treating with bichromate each minute silver particle obtains an envelope of insoluble gelatine surrounding it, as a result of which the enclosed dye is rendered difficult of attack by chemical reagents, whilst the dye or pigment in the untanned parts of the gelatine is easily removed. The blue-green gelatine complementary to the orange coloured rays allows to pass only the blue-violet and green rays of white light, which on printing are absorbed most strongly by the yellow and purple bromide grains. After decolorisation of the blue-green parts of the gelatine the two remaining dye constituents produce by admixture the *minus* orange when viewed by transmitted light or against a white background.

The defect of this method lies in the fact that we know of no dye which permits a powerful sensitising action on bromide of silver for rays of long wave-length greatly exceeding that for those of the strongly refrangible rays.

The second case to be described concerns the conditions where a number of silver bromide grains are rendered accessible (through an envelope of stained gelatine) only for a certain kind of light. If the silver bromide is sensitised in the manner already stated the dye above employed (or one used as a filter only and possessing no sensitising powers) can be used for the dyeing of the image. We shall deal here only with the latter case—namely, the dyeing of silver bromide emulsion in minute particles with yellow, blue-green, and purple, or blue-violet, orange and green, to form a neutral dark grey mixture, which is made in such a way that the operations of dyeing, development, and fixing do not give rise to any mixture of the separate dyes owing to diffusion. The most simple method is to prepare the emulsion with so much alcohol or acetone that on ripening at the necessary temperature it remains clear, being afterwards vigorously stirred whilst being cooled in a freezing mixture to about 10 deg. C. The silver bromide then forms as a fine-grained sandy powder, and is dyed with alcoholic solutions of colouring matters which are insoluble in water. These dyes naturally should not be attacked by the developer or other solutions. The powder is shaken up with alcohol to reduce it to a further finer state of division, and the alcohol removed with water. The differently dyed portions are then combined to form a mixture by using a cold 1 per cent. solution of gelatine. The coloured image is produced either by bathing the bichromate-treated plate in alcohol or by decolorising the pigment in the unhardened parts of the plate with weak acids, etc. In certain cases it is well to dye the silver bromide emulsion (which for this purpose should be prepared as a dry powder) with water-soluble dyes, supposing that an actual dyeing takes place and the colouring matters are only slightly removed on long washing.

As an alternative method of preparation which appears possible the following may be mentioned:—Mechanical disintegration of the emulsion by pressing through fine apertures, combination of the threads to a thick bundle and cutting up into thin films. The sensitisers for yellow-green and red-orange which can be easily washed out—e.g., erythrosine and Wollschwarz 4 B, which should strongly dye the silver bromide grains, are removed from the gelatine by washing, any residual dye adhering to the bromide of silver being removed after fixing. The fact that a filter dye in many cases exerts a dyeing action on the silver bromide requires no comment. Emulsification in gelatine of collodio-gelatine or collodion emulsions can be adopted (as in the cases previously mentioned), having regard to the solubility of the dyes in the emulsifying medium, which is not without influence on the result and permits a strong partial sensitising with greatly diminished blue sensitiveness. The two classes of emulsion just alluded to may be easily precipitated with water at a fine sandy powder. On treatment with bichromate the silver particles surround themselves with a corresponding envelope of hardened gelatine. Collodio-bromide emulsion, which is rich in silver and contains sensitiser, can also be introduced into gelatine containing a filter dye and the mixture broken up mechanically.

On following the course of the rays in such a plate it can be ascertained that each of the dyed emulsion particles contains the silver halide uniformly throughout, since it appears difficult in practice to surround a silver bromide grain with a gelatine envelope containing no silver. It is not the absorption of the rays which fall upon the surface of a particle but the absorption by underlying layers which decides the formation of an image in the correct colours. For example, a blue ray acting on the orange-coloured particles, which are sensitised with Wollschwarz 4 B for this particular light, can influence only the molecules of silver bromide lying on the surface where the action of the filter dye in the plate is not exerted. Action, on the other hand, in the depth of the film is produced only by the orange ray. On this same principle depends the addition of picric acid to the erythrosine dye bath, first recommended by Vidal, as also the dyeing of the complete film of orange colour in order to avoid the use of a separate yellow screen. The slight error which is caused by the excessive activity of rays of short wave-length in spite of the use of a separate filter is compensated for in the development of the coloured image, for it should be borne in mind that even the strongly tanned gelatine is gradually penetrated by aqueous solutions if only in relatively small quantity. As not only the silver molecules of each superficial particle of emulsion are exposed most strongly to the action of rays of short wave-length, but also the insoluble envelope of gelatine is exposed to the action of the solutions or other chemical reagents, so, on development of the coloured image, dye remains in the interior of each particle corresponding to the rays absorbed. In order to obtain complete action throughout the depth of the film the rays of short wave-length must act on the blue-violet grains, whilst the insoluble gelatine formed on the surface of the stronger coloured orange and green particles can be decolorised by longer action of the solvent liquids. A yellow ray falling on the plate is absorbed partly by the orange-coloured particles and partly by the green particles lying underneath; action on the blue-violet grains which are not sensitised for yellow cannot take place. A ray of white light, which has to pass the orange and green particles lying one behind the other, produce on the eye (by a subtractive process) the effect of yellow.

In the two methods already mentioned the differently coloured sensitive grains of silver bromide are irregularly mixed throughout in order to avoid errors of regular overlap; also to render possible the access of the various solutions acting on the dyes (even after the hardening of large portions of the surface) to the particles lying deeper, particularly when a suitable emulsion vehicle is being used.

The images obtained must be printed, as white and black appear reversed in the taking plate, and their automatic reproduction by this process would scarcely be possible; the reproduction of the colour does not exclusively follow the subtractive process, but is more or less additive, as in three-colour work. According as the light action penetrates less than the complete thickness of the film, the reversal of the negative into a positive transparency produces in general no coloured image, but it probably does so in the two other kinds of arrangement of the silver grains to be described, where the particles are in three films lying one over the other of equal sensitiveness, or in one film of different degrees of sensitiveness.

A special case of the first kind is analogous to the transfer process customary in carbon printing. Three films of silver bromide emulsion are laid one upon the other upon a support with intermediary films of colourless gelatine. The uppermost silver film is thin and not sensitised yellow for the blue-violet, the middle, purple, is sensitive to the green, and the lowest, blue-green, to the orange rays. Each film serves as a light filter for that lying underneath it, and the dye of the latter can at the same time serve as sensitiser for the silver bromide, a water-soluble dye being used as a rule and the alcoholic solution of the similarly coloured pigment (insoluble in water), added whilst stirring the emulsion. In order to avoid any screening action the colouring should be only slight. As the absorption of light by three equally thick and sensitive films laid upon each other is, according to Gaedicke, about two-thirds, only one-third passing the three films, corresponding differences in the strength, sensitiveness, and colouring of the films can be made, in order that, by the use of a yellow filter, the lower sensitive layers may be affected to the same degree as that on the surface. In order to help the penetration of the solutions into the film the addition of starch, sugar, etc., to the emulsion may be recommended, or the plate may be given a preliminary exposure through a screen ruled into fine parallel lines in order to avoid white points or lines in the image. Development and removal of the reduced silver with permanganate, or, still better, with saturated ammonium persulphate or acidified peroxide solution, forms the latter part of the process. The image is formed on the subtractive principle; that is to say, a ray of white light loses its violet constituent in the upper film, its green in the lower, and its red rays in the lowest film. On printing, these three films obstruct the passage of white light, and the positive therefore at this point is decolorised for want of deposition of silver, and appears white. The process can be simplified by making a colour-correct polychrome image in such a way that the silver may be removed from the plate, exposed through the screen and object, after which exposure to white light, development, treatment with bichromate for the removal of the silver, and finally the re-development of the coloured image conclude the process. The same effect is produced by passing the plate bearing the three films under a comb formed of needles, but the developable bromide of silver formed in consequence of the pressure must be removed with permanganate.

Development of the colours in the case of highly contrasted negatives may be done with warm water if one applies, between the separate colour films and to the uppermost, a film of hardened gelatine or of collodion, providing all six films, with many minute openings which penetrate the whole substance of the film. In the case of great thickness of film it is advisable to employ a lens which is not too completely achromatised—that is to say, one in which there is a chromatic difference corresponding with the distance of the blue-absorbing film from that absorbing red. The enlargement of the red image does not exert a disturbing action so much as does the error due to the unsharpness of the other films. The diffusion of the light within the bromide emulsion film, as shown by microscopic photographs of sections of an exposed and developed film, has less to do with the result than is usually supposed. In place of three-colour films, two only can be used, as adopted by Gürtner.

In opposition to the above described methods, by which the rays of light chiefly act according to the laws of subtractive colour analysis and are reproduced on the same principle, there is still a third arrangement of the grains of silver bromide, that is to say, in one film strongly dyed violet, red, and green, and possessing a corresponding sensitiveness. This gives a result only by additive methods. In the case of a pure dyed image of this kind black cannot be reproduced since dark parts of the object exert no action, the colour is removed and the result by transmitted light is white. The reversal is no assistance in this case. A correct colour reproduction would be possible in the case of pigment giving partial reflection on a dark ground. For this purpose semi-transparent mineral colours might perhaps be used, or the separate coloured emulsion grains mixed with colourless materials, which on after-treatment with suitable chemical substances would give the respective reflected colours. A correct complementary image is, however, obtained if the parts affected by light remain darkened by the reduced silver left therein. This variation of catachromy resembles to a certain degree the three-colour methods of Joly and Lumière, but is distinct from the latter's Autochrome process in that the colour filters are distributed direct in the differently sensitised part of the film, and further that the tedious preliminary application of the film of coloured starch grains is not necessary. In the case of a plate coated with intensely dyed particles of silver bromide arbitrarily mixed, the result, on exposure to white light, is that the latter is absorbed by those which first meet it which act as though they alone were present in the surface. This plate is exposed and developed, treated with bichromate, and the silver removed. After further exposure to white light, whereby again only the silver bromide in the superficial portions is affected, it is developed and fixed and the dye removed from the unhardened portions with alcohol, a correct colour print being obtained. If the rays of short wave-length are cut off at the time of exposure the development of the coloured image can also be done in warm water, according to the usual carbon process, but in this case, after again hardening with a second development, it needs to be again pointed out that, on account of the defective panchromatic properties of silver bromide when suitable filtration of the blue-violet rays is done, no filters are necessary in order to secure the proper selection of the yellow and red rays. Assuming the use of three dry plates, one of which is of slight general sensitiveness and not sensitised for violet, the other sensitised strongly to yellow with erythrosine, and the third dyed strongly red with Wollschwarz 4 B, in the case of yellow-green rays falling on these plates the influence is only on the erythrosine plate, the yellow-green dye of which, after treatment with bichromate and alcohol, remains, whilst the two other plates are decolorised. Red spectrum light acts less on the films sensitised with Wollschwarz and not at all on the other films. Only the violet rays passing through the yellow filter show a slight blackening on the violet plate near to the maximum action in consequence of the superficial absorption of the yellow-green and red. The slight coloration, however, which takes place as the result of this can be removed by finally treating the three plates with alcohol. By using a sufficiently dark yellow screen things can easily be arranged so that white light exerts a far slighter action on the violet plate than on the other two. As regards the very fine grain there are no difficulties in surrounding the sensitive grain with a gelatine envelope, free from silver. For this purpose the grains of silver bromide or of silver bromide emulsion in gelatine, collodion, etc., are moistened with warm or cold gelatine solution which contains a filter dye. This is added gradually, with stirring, to very cold water or alcohol, whereby each part of solidified or weakly coagulated gelatine receives a coating which acts as a light-filter. The particles thus holding the silver bromide can be easily separated from the gelatine particles floating in the solution.

Methods of conversion of the black silver negative into a coloured image may be conveniently divided into the direct processes in which the dyes are directly acted upon on suitable treatment of the metallic or the silver halide, and the indirect methods in which the gelatine is first affected and the corresponding colour tone subsequently obtained.

The indirect process, originally introduced by the author, depended upon the catalytic decomposition of hydrogen peroxide for the oxidation of the dye in the exposed parts of the negative. This method soon proved to be impracticable, as the liberation of oxygen within the film broke up the image, and, moreover, the suitable aniline dyes are extremely fugitive. As a result of the action of bichromate the chromium oxide forms insoluble lakes with several dyes. Many materials again dye silver bromide so strongly that they will wash out only from those places where the loose combination of silver bromide and dye has been destroyed during development. To other possible methods, such as fixation of many colouring matters by finely divided porous silver, changes of pigments by the chemical alteration of silver, or better, by the development of oxidation products, only this passing reference is necessary.

As regards indirect processes, there is a choice of removing the gelatine with the enclosed dye, or employing the physical difference between tanned and soluble gelatine for the production of the image.

The processes in which the removal of parts of the gelatine takes place are in general only applicable to methods of catachromy, based on additive synthesis. In the exposed parts the silver, with the gelatine containing the dye, can be removed by treatment with a saturated solution of ammonium persulphate, or an acidified dilute solution of hydrogen peroxide. The gelatine can be dissolved with warm water from those parts of the image (unexposed) which have not been hardened on treatment with bichromate, providing, of course, that the exposure has been made through the glass.

The tanning of the gelatine in those parts containing silver takes place in a bath of bichromate, as first pointed out by Farmer in 1894. The bichromate is reduced to chromate by the catalytic activity of the finely divided silver, the chromium compound forming an insoluble combination with the gelatine. The chromium oxide does not appreciably alter the colour of the dye, and can, if necessary, be removed with dilute sulphuric acid. The strong visible relief produced on swelling in water is no less than that obtained on exposure of bichromated gelatine. It should be mentioned that the slight hardening of the gelatine by many dyes as well as the equally slight tanning on treatment with alcohol has no appreciable effect on the action of the bichromate, and is in fact an advantage, since a strong solution of ammonium bichromate dissolves the unexposed parts of the gelatine by protracted treatment. Tanning of the exposed parts is also produced by many developers, especially pyro, a fact which was emplayed by Warnerke for bichromate printing. Of other similar processes, that of Constet, in which the unexposed parts are hardened with ferric chloride, may be mentioned.

The gelatine hardened by the reduced bichromate, unlike the unhardened gelatine, is insoluble in warm water, and is penetrated with great difficulty by aqueous solutions and still more so by alcohol. It is to be noted that the tanning is exactly proportional to the intensity of the light action, the smallest catalysing particle of silver giving an envelope of insoluble gelatine.

The great difference in the rate of absorption and diffusion of aqueous solutions in soft and tanned gelatine may be employed by taking advantage of the removal of dyes from the unhardened gelatine by physical or chemical reagents, or by conversion by means of acids or bases into colourless compounds. It is easy to obtain an idea of the great difference in the rate of diffusion by bathing in alcohol a glass plate bearing three gelatine films, one upon the other, each containing spirit-soluble aniline dyes, the uppermost film being strongly tanned and provided with numerous apertures through which water can pass. After several hours the two under films will be decolorised, whilst the upper will have lost scarcely anything in intensity.

It is scarcely necessary to mention the gelatine process with transfer employed for pigment printing by exposure of bichromated gelatine, a silver print being pressed in contact with the moistened surface of the latter. As to the correctness of the catalytic bichromate process the following simple experiment will allow of a conclusion being formed:—An ordinary dry plate is dyed strongly by bathing for one half-hour in an aqueous-alcoholic solution of fuchsine, it is dried and, after exposure, the negative is developed with ferrous oxalate and laid for half a minute in a 20 per cent. solution of ammonium bichromate until it shows strong relief. After removal of the metallic and haloidal silver with Farmer's reducer it is thoroughly washed in order to avoid the after appearance of dyes insoluble in alcohol within the film and, after drying, the dye removed by soaking in frequently renewed alcohol. If, in place of pure spirit of wine, the plate is laid in an alcoholic solution of spirit-soluble alkali blue scarcely a trace of blue colouring will be observable in the parts consisting of soft gelatine, to say nothing of the hardened portions.

Reference may also be made in this place to the production of three-colour screens as by the Lumière or McDonough processes. For the preparation of these latter attempts must be made to select from an arbitrary mixture of coloured particles on the surface only those which lie in one plane. This may be carried out in two ways:—First, the dyes or coloured particles upon the surface may be transferred to a new support, or they may be left in the original vehicle and the action enhanced by other elements. Of the many ways in which this can be done the following may be mentioned as examples. Particles of gelatine, kaolin, and similar materials differently stained with water-soluble dyes are finely distributed in wax, collodion, etc., the mass cut into sections, and the sections brought into contact with a moist gelatine film into which the colours in the particles on the surface slowly diffuse.

Films of soft gelatine stained with spirit-soluble dyes are laid one upon the other and cut vertically into thin films which are transferred to glass bathed in bichromate, and, after drying, exposed from the back. On dissolving out the unhardened parts with warm water a screen is obtained of thinness varying according to the intensity of the light and of a degree which may be easily controlled with the Vogel photometer, but is beyond the power of the microtome. The superficial tanning of the gelatine film to be transferred can also be done by means of chrome alum, which, like other chemical bodies, diffuses only gradually into the gelatine or the emulsion. Small particles of strongly hardened gelatine emulsified in soft gelatine may also be impregnated with spirit-soluble dyes, the films obtained either by coating or section cutting, exposed for a short time after bichromating and drying and developing in the warm. In this way the particles on the surface are exposed and the silver negative is converted by the usual methods into, in this case, a screen-colour picture. In all cases where only the superficial particles can be affected by the light the use of an emulsifying vehicle dyed to a dark colour is of advantage. If grains of a strongly aqueous gelatine emulsion are distributed in wax it is easy to transfer the grains (which after drying have been compressed to a tenth or still less) from the sectional surface to a moistened gelatine sheet, particularly when the colour elements are deprived of their hold by solution of the wax. The exposure of the chromated section of coloured strands or threads, united (by pressure or with gelatine) to a bundle, and with the unhardened parts removed with warm zinc chloride solution, gives a less favourable result than the superficial conversion of the colouring matters by the formation of insoluble lakes and extraction of the unaltered residual colours in alcohol.

KARL SCHINZEL.

EASTMAN PLATE COMPETITION.—We are asked to remind intending competitors that the first section of this competition closes on August 20. Cash prizes to the value of £240 are offered by Kodak, Limited, for negatives made upon Eastman plates by amateur photographers, special classes being provided for those who have never won a prize in a previous photographic competition, and for negatives developed in the Eastman plate tank. The second and third sections close respectively on September 21 and October 20. Full particulars can be obtained from any dealer, and from Kodak, Limited, 57-61, Clerkenwell Road, London, E.C., and branches.

"THE HOLIDAYS: WHERE TO STAY AND WHAT TO SEE," is the title of a voluminous guide-book which deals with the chief holiday resorts of the United Kingdom in the districts served by all the principal railway systems. One of the chief features of the book is the extensive list of hotels, boarding-houses, seaside, farmhouse, and country lodgings, etc., which is arranged in alphabetical order and quite easy of reference. Brief topographical details of the chief places mentioned in the book are also given, together with a quantity of miscellaneous information suitable for, and interesting to, all classes of tourists and holiday-makers. The latter portion of the book is devoted to the chief holiday haunts of Brittany. The volume may be obtained from any newsagent or railway bookstall at the price of one shilling, or direct from the publisher, Mr. Walter Hill, 67-9, Southampton Row, W.C., for 1s. 6d. post free.

THE WESTERN COUNTIES PHOTOGRAPHIC EXHIBITION.—The prize schedule of the Western Counties Photographic Exhibition, to be held at Plymouth on November 4 to 21, 1908, has come to hand, and we note a most liberal offer of prizes in connection therewith. There are thirteen classes, embracing seascapes, landscapes, street scenes, architecture, still life, portraiture, lantern slides, etc., most of which are open to competitors in the United Kingdom, whilst a special prize, Class A champion, is open only to those pictures that have already won a first prize in any open competition. The awards, consisting of large gold, silver, and bronze shields, mounted on old oak, are very handsome, and should lead to a considerable number of entries. The judges are Messrs. F. J. Mortimer, Esq., F.R.P.S., and Walter Finch, Esq. A detailed schedule can be had on application to the Secretary, Mr. A. D. Breeze, F.C.I.S., Great Western Chambers, Plymouth.

No. 21. Vol. II. SEPTEMBER 4, 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

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ALONG THE THAMES WITH THE AUTOCHROME PLATE.

[Interested by the announcement that Mr. J. McIntosh, secretary of the Royal Photographic Society, would fill the lecture bill three nights weekly during the run of the exhibition at the New Gallery, and that the lantern illustrations were Autochrome transparencies made by him during the past summer, we took the occasion to interrogate Mr. McIntosh on his recent experiences in the Autochrome process. The following report of a conversation with him on his return to Russell Square after a brief vacation, will doubtless be read with interest by those who attend the New Gallery lectures. We ought to say that the lecture is divided into three portions, each given on a different night of the week.—Eds. "B. J."]

"Can you give any information about the lecture on the Thames which would be interesting to the readers of the 'British Journal'? For instance, how came you to select that subject?"

"Well, the Thames ought to be interesting to Londoners; it is a picturesque river; it is the kind of subject which could be dealt with in odd days and half-days snatched from other duties, and, without requiring any elaborate plan, the river links together in a convenient scheme the scenes on its banks."

"Do you think the public take as much interest in the Autochrome process as they did during the exhibition last year?"

"Not in the same way perhaps. Last year everyone was anxious to see examples of the new process. By this time probably everyone has seen examples, but there is no reason why a lecture illustrated with Autochrome slides should not be as popular as one illustrated with monochrome slides. Years ago we were told that the days of the lantern lecture were numbered, but during the last few years the evening audiences at the New Gallery have increased so much in numbers that the lecture room cannot accommodate them. It has become imperative that the Gallery should be open every evening, and the Autochrome lecture appeared to be the most desirable way of filling up the gaps. In the course of time most lantern lectures will probably be illustrated partially, if not entirely, with slides in colour. Mr. Martin Duncan, you will have observed, will show some Autochrome slides, and the action of the Society will no doubt encourage others to do the same."

"You have had some experience now in Autochrome work. Can you give any advice on the matter?"

"The plates I have had this year are distinctly more sensitive than those which were supplied at first. Last year I agreed with other workers that the speed number of the plate was 2 Watkins. Those I have been using lately have a speed of at least 3, probably nearer 4. The plates are also better in another way; last year there was very frequently a ridge of emulsion near to one side of the plate, which was much thicker than on the general surface, with the result that after the second development a dark band appeared. As it was impossible to know before development on which side or end this would come, the useful area of the plate was much diminished. The plates now are either better coated or the ridge of emulsion is cut off before the plates are issued."

"I believe you have overcome the objectionable pink sky in landscape subjects, and have blue skies and white clouds. Can you give any advice on this matter?"

"Very little more than I said soon after the plates came over. It was commonly stated then that pink skies were the result of over-exposure. I believe that to be largely a fallacy. The pink appearance is due, of course, to the whole of the silver being dissolved from that part of the plate in the process of reversal, and so exposing entirely the grain screen, which is pink in tint. If white or blue skies are to be reproduced correctly some silver must be left to be acted upon by the second development. The cause of the defect is in carrying the first development too far. Over-exposure may lead to over-development, but I believe that under-exposure is more frequently the original cause. For example, a landscape having strong shadows in the foreground will require an exposure ten times too long for the sky, and by the time the foreground is sufficiently developed the silver in the sky part will have been reduced right through the film. So far, it may be said that the fault is due to over-exposure of the sky; but if double the previous exposure be given to another plate on the same subject, and if development is continued for, say, one minute forty-five seconds instead of for two and a half minutes, both landscape and sky will appear on the plate."

"You invariably pursue that practice then?"

"Not invariably, for wind or moving objects may prevent me from giving the required exposure. Also the degree of contrast varies in different subjects, and frequently I do not graduate the increase of exposure so nicely as I would like; but by keeping a close watch on the plate during development I can generally judge the time correctly."

"As you work by the dark-room lamp, no doubt you employ the new developer which is said to partially desensitise the plate to the action of the light?"

"Yes, I use the new developer, because it does not discolour so rapidly as the old, but I never found any evil effects from exposing the plate—judiciously—to light while using the old formula. Incidentally, I may refer to the black fog said to be the result of exposing the front of the plate to red light. Light, red or white, falling on the front of the plate, cannot produce black fog in the finished picture. It will give fog while the plate is in the negative stage, but in the finished picture it either lightens all the colours or obliterates the image entirely. Red light falling upon the back of the plate will give rise to a red tint, for it passes through the red grains only. Blue fog I have never met with, but I believe it is due to white light falling upon the back of the plate without first passing through the yellow compensating screen. This may easily occur if the yellow screen does not fit close to the lens hood, for, if light passes between, some of it will be reflected from the inner surface of the screen through the lens. When the finished picture is fogged in patches it is due to incomplete reversal. When the whole picture is dark and muddy, the cause is probably under-exposure, and certainly under-development. Over-intensification will also give a dark picture, but in that case the colours will be crude and inharmonious; broken colours, such as grey and brown, will be represented as blues and reds. While we are on the subject of failures, I may refer to black spots, with which a good many workers are troubled; I have suffered greatly from them of late. When the spot is small, with clearly defined edges, it is probably due to dust on the back of the plate. When larger, but still circular and with a clean edge, the spot may be due to an air-bell in the first developer, particularly if the work is done in total darkness. The majority of these spots, however, are long in shape, with ragged vignetted edges. Sometimes the spot is like a comet with a tail, and I have heard it said that these last, at any rate, are due to undissolved particles of developer falling on the plate. That is a manifest impossibility, since these particles would cause black spots in the first development, changing to clear spots in the finished picture. As they invariably appear as white in the first development, they seem to be due to matter in the emulsion which either densitises it or repels the developer."

"Have you tried any of the suggestions that have been made for the purpose of reducing the number of solutions and operations?"

"I have tried most, if not all, of them; but while I do not deny that occasionally they give good results they are not sufficiently flexible for general use. The merit of the nine solutions is that slight faults in exposure or development can be remedied. An intensifier acting similarly to pyro-silver is absolutely necessary. It may be taken as axiomatic that a plate (however good it may be) which does not require, or permit of, intensification is not the best possible, since if the particles of silver which cover the spots of colour not required are sufficiently dense, then the spots of colour which should be uncovered will be partially fogged, with the result that the whole picture is dark. On the other hand, if the general density is not sufficient, the colours will lack brilliance and purity.

"A reduction in the number of solutions is easily attained, though I think those adopted by the makers of the plates are, taking them all round, the best for the purpose. The silver intensifier is the only one which is really troublesome. One or two plates may be finished, and the stain removed from the fingers with comparative ease, but when twelve or more plates have to be manipulated in rapid succession one wishes for something of a less staining nature than pyro-silver. I made some experiments with other salts of silver than the nitrate, and with other developers than pyro, with partial success, but the results were too uncertain."

WHERE WE STAND IN PICTORIAL COLOUR PHOTOGRAPHY.

THREE years ago "The Studio" published one of its special numbers with the title "Art in Photography." That work, which is now out of print, did much towards ensuring a place for photographic pictures amongst those of the graphic arts. The same eminent periodical now issues a special number* dealing with "Colour Photography" and other recent developments of the art of the camera. The former volume, of course, treated of a state of things that had already been carried far, could boast of some fine traditions, and included many aspects and many methods. The book was therefore a kind of mile-stone or landmark, set up by a periodical outside the ring of photographic journalism. These conditions gave it much weight and interest, and its popularity is proved by the fact of its being now out of print. It is to be feared that similar conditions will not obtain with the present work. In the first place colour photography is as yet in swaddling clothes. It will not be possible to consider it adolescent until it has emerged from its transparency stage and has become a thing upon an equal footing with all other photographic records. For "The Studio" implication is that the single exposure is the only birthright of real colour photography, and hence all the methods of superimposition of films or plates, and the triple projection method also, are not recognised. One does not feel disposed to quarrel with such a conclusion, for it is from the world at large that the long-awaited invention must win its recognition; not from experimenters themselves, however fascinating their results may be, or however valid their claims. The great public, typified by "The Studio," has probably not been in ignorance of all that had been done before the advent of the Autochrome plate; but it has answered to the appeal of a plate which is like an ordinary plate, is exposed in an ordinary camera, developed in a not very extraordinary way, but withal capable of producing most extraordinary results. Hence to the man in the street it constitutes the Simon Pure colour photography. He is under no obligation to understand what precursors the Autochrome has had, or what other plates are waiting their cue at the wings. The name of Lumière will certainly go down to posterity as that of the inventors of colour photography.

It is only on this account that "The Studio" can be justified in presenting nothing but fourteen very indirect Autochrome results and calling them colour photography. We may doubt strongly the justness of taking the tentative groping of eight men, many of whom are opposed to "straight" processes, and letting their experimental work go out to the world as the best that the Autochrome plate can achieve, for that is how it will be received. Fortunately for the authors of these pictures, they have excellent cover in the fact that their plates are reproduced by the three-colour process. Yet after making ample allowance for the difference between the foreman printer's colour and what the colour of the originals must be, the opinion remains that, as an exposition of colour photography in the summer of 1908, "The Studio" volume will unjustly disappoint its readers. We trust that the plates exhibited last year and this at the Royal Photographic Society's exhibition, at our own rooms, and at the Franco-British Exhibition will go far to restore the balance of fair judgment in the matter of colour-screen plates in the mind of the public.

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* "Colour Photography." Special Summer Number of "The Studio." London. 5s. net.

In the first place, are the gentlemen who furnish these examples known as having been eminently successful as Autochromists, or have they not rather the reputation of being artistic photographers to whom processes, as such, are as nothing? It is, of course, of the greatest interest to see what Messrs. Annan, Coburn, Eugene, Kühn, De Meyer, Rawlins, Shaw, and Urquhart can make of the new plates; but would it not have been of greater interest, in the first illustrated work offered to the public, and dealing with this subject in such an auspicious way, to see what the Autochrome plate can do of itself in the hands of a good and unsophisticated technician?

"The Studio," in its unquenchable thirst for art manifestations, has no doubt thought that it could say its best word for colour photography by going to art-photographers. It may find that this was not a wise course. Control in monochrome photography may be possible enough and may result happily five times out of ten; but control in an Autochrome plate can surely be, at any time, nothing but a desperate resource for getting out of a muddle or repairing some initial blunder. When one thinks of the inexorable laws that govern the simple processes in the working of Autochromes, the idea of controlling them seems as impossible as the controlling of the colours of the rainbow. We may alter or derange the processes to any extent and we shall get a result of some sort; but whether that result will be a finer one can only depend upon individual notions of what is fine. As colour photography, such a result must certainly be one or many removes from the scientific and theoretical perfection which the inventors have laboured to secure. It should be an operator's prime object to have all things as rigorously in order as possible, so that nothing may balk an ideal result. That plates have been made showing both marvellous accuracy of colour and great beauty, nobody dare deny. Especially has this occurred in still life and interior work. Landscape seems yet to baffle most attempts.

Not for a moment is the right denied to Mr. J. Craig Annan, to take him as an example, so to control his work that his portrait of Miss Jessie M. King is practically a monochrome in green. He, and his sitter too, may admire it; but it cannot be called a conquest in colour photography. It is a pity that "Art" is so much with us. When will people develop that real artistic faculty of seeing beauty in the commonplace? The out-reaching, the striving, the wandering into strange paths, may bring us new and quaint ideas; but they are not necessarily beautiful ones. The mind that is always in quest of art, always labouring for it, overlooks the art that lies waiting close at hand. Mr. Coburn's "Blue Dress" is more ordinary, and in many ways extremely nice. The trellis and white wall at either side of the figure are, in the writer's opinion, aggressive and redundant, the picture gaining much in simplicity and strength when they are obscured by a mount. I know that Mr. Coburn will expand his ready smile at this, amused at the audacity of my differing opinion; but I am not asking him to prune his print for me. The colour of the dress is, in the printed version, without the quality of broken colour which Autochromes *can* give; therefore it is to be presumed that the "fine-etcher" has been at it again on the colour blocks. His "Autumn Landscape" only approximates to the colour of nature, the distant trees being dense and colourless and the grass absolutely unconvincing. Here, again, one feels that it is not fair to saddle the plate with the sins of printers' ink, and the same reservation must hold in the next example by the same worker, "The Lady in Red." The brick wall also and some of the ivy are "in red"—the same red. If this monotony appeared at all in the plate it was an unsuccessful plate, and should not have been included. Mr. Frank Eugene's brilliant window scene called "The Sisters" is "as hard as nails," but it has the virtue of showing how nearly, even through the medium of printer's ink, the Autochrome can seize the less subtle colours of nature. Unfortunately, the light and shade is in such violent contrast that what is not brilliant colour in this example is unmitigated black. That fault is not due to the process at any rate. The distressing "patterning" in the dark distance of the room beyond the two figures is probably due to the grain of the three blocks. A portrait group by Herr Heinrich Kühn differs from the last in being very soft in treatment, except in the hair of the lady, which is hard and edgy. The head of the little girl has excellent quality, and is perhaps the best thing in the whole book. But strong and rich as the picture is, one pines for those greys and retiring subtleties which appear to be out of the range of the process. The background is of a strong twangy green, very heating to the remaining parts. If it is true to the actual background, then such a fierce contrast of unmitigated colour was a bad selection. Kerr Kühn's next picture, "Playmates," is quite charming in subject; but the background to the three little back views is incomprehensible. Presumably, it is a shaded pool; if so, it fails in presentment. Again, the dark shadows are too devoid of colour and too degenerate in tone. All sorts of tints seem to come in the wrong place in Mr. Rawlins's portrait of "Mrs. W. M.," and the general mellow warmth over all points to something wrong somewhere. As for Mr. G. B. Shaw's "Landscape," the less said about it the better, except that one can understand his impossibility to see where art and artists come in in the world's economy, if this is his idea of what a landscape should be. Absolute want of relative tone ruins Mr. Urquhart's "Christmas Roses."

The most interesting part of "The Studio" volume is really the able and elegant article supplied by Dixon Scott. True, the author does talk of the "sensitive and meticulous loyalty" of the reproductions, and further reassures the reader as to the "evidence" upon which judgment is due. In that he is directly opposed to the editor, who craves indulgence for the colour printers' version of the Autochromes. But his reasoning and observations are sound and true as to colour photography compared with painted pictures. The former he describes as "piquant, curious, and staccato," and asks, "can it really be said of them that they compel that swift unmistakable stir of the senses—half rustle of contentment, half thrill of disquiet, which is the body's signal of the presence of authentic art?" Who will with honesty answer this affirmatively? The article insists upon the "extravagant accuracy of the final image" and the "total inability to modify." These two facts are less well established than one could wish. They are theory. Unfortunately practice gives the lie to them. The "odd effect of acidity, of asperity," is due, the writer affirms, to "this fanatical truthfulness." As a deeply interested person in these matters, I may be allowed to suggest that it is perhaps in landscape work that this asperity chiefly occurs; for interiors and still life may, in good hands, be harmonious and sweet, and true into the bargain. Mr. Scott points out, with much happy phraseology, the truth about the beauty of landscape as it appeals to the artist. Painters know full well that the charm of colour is to be found in what Mr. Scott calls the feuds and alliances that go on between the colours themselves. Everyone must know that colour which is most exciting and inspiring to one person leaves another unmoved. In fact the beauty of colouring is a subjective affair altogether, depending entirely upon the sensitiveness of the observer's "rods and cones," as well as to mental culture. He who can put down in paint what he sees in the reactionary and relative tints of a view can convey the colour beauties as he sees them and give pleasure to others who would never find those delights before the actual landscape—even if the artist were there to preach. But an Autochrome plate does not suffer from that glorious weakness, retinal fatigue, and therefore the colours it records do not influence each other; but are purely local colours. When the acute reduction in scale and its consequent intensification are taken into account, the acidity and asperity of the Autochrome, piquant and staccato, is fully accounted for. In the larger scale and closer view of interiors and portraits local colour tells for more, and the Autochrome may be made beautiful by the mere beauty of its subject.

This observation brings us exactly to the conclusion arrived at by Mr. Scott that there is really only one way to "photographic artistry," to "temperamental expression," and that is what he calls Creation by Isolation, which may be explained as the mise-en-scène method. Arrange your subject to your best ability, select, compose, and be artistically happy; then let your Autochrome do its best with its greatest advantages of "straight" and unsophisticated manipulation. Result: colour photography, a scientific, mechanical, automatic process, seizing and perpetuating an artistic theme.

F. C. Tilney.

THE "UTO" BLEACH-OUT PROCESS.

[Inquiries as to the present technical state of the bleach-out process continuing to reach us, we may take the opportunity of printing a communication from Dr. J. H. Smith, in which is contained an account of the latter's later work, particularly in regard to increasing the speed of the paper and employing it for preparing copies from Autochrome transparencies.—Eds. "Colour Photography" Supplement.]

On leaving Zürich at the close of last year, my work on the bleach-out process of colour photography was unfortunately interrupted for some time, but during the last few months I have had opportunity of working again upon the "Uto" process of making bleach-out paper, and more particularly in the adaptation of the latter to printing from Autochrome plates. Important improvements have been the result, a short account of which may be of interest.

"Uto" Emulsion.—The last papers manufactured in Zürich, although considerably improved in quality, more especially in their adaptability to printing from ordinary window transparencies, did not prove satisfactory for printing from Autochrome plates. This was due not, as some critics inferred, to some inherent defect in the bleach-out process itself, but simply to a want of regularity in the bleaching action of the various dyes and sensitisers at our disposal.

As I have shown before, it was possible to adjust the sensitiveness of the various dyes so that in a short time of copying, such as was necessary for printing from window transparencies, etc., exceedingly good and faithful copies of the originals could be obtained, the slight irregularities in the speed of bleaching of the different colours not being conspicuous. In copying Autochrome plates, even with the assistance of the printing frame with inclined mirrors, which I described last summer, the irregularity became noticeable. With freshly prepared paper, however, fair copies could be obtained, but, unfortunately, the irregularity increased on keeping the paper even for a short time, and this is the chief reason why so many failures resulted.

This alteration in the sensitiveness of the different colours on keeping I have traced to the volatility of certain sensitisers employed. I have examined a large number of new sensitisers, and obtained very interesting results. Some of these bodies are so energetic in their action that the addition of one part to fifty thousand parts emulsion is sufficient to turn the scale of colour obtained in bleaching right over to the complementary.

Unfortunately, some of the most active sensitisers are exceedingly volatile; other excellent sensitisers, again, can only be added in small and quite insufficient quantity to the emulsion, on account of the disagreeable property they possess of separating or "sweating" out of the emulsion as soon as it is coated on paper.

Anethol is almost the best sensitiser in this respect, as it can be added in large quantities without separating from the pyroxyline, due largely to its high temperature of solidification. Peppermint oil and some other oils of the mint and cinnamon classes sensitise quite as vigorously as, or even more so than, anethol. They could not be employed, however, in sufficient quantity for the reason stated.

I have now been able to overcome the above-mentioned difficulty by the introduction of bodies into the emulsion, which have the property of binding these sensitisers and at the same time reduce the tendency to volatilisation. By this means I have been enabled not only to regulate the bleaching out of the individual dyes more accurately, but at the same time to obtain a better keeping quality. Nevertheless, I see no prospect in the immediate future of being able to prevent the volatilisation of the sensitisers altogether, and it will doubtless be necessary to resort to packing the finished sheets of paper face to face in tinfoil.

It has been an exceedingly difficult task to adjust the sensitiveness of the dyes so that all bleach out regularly, and I was particularly desirous of adjusting this in the emulsion itself without having recourse to employing colour screens in front of the printing frame, as Szczepanik has recommended. Of course, this could always be resorted to in the case of extremely difficult subjects, or of paper which had not been kept carefully; but for the bulk of ordinary work I hope to dispense with this appendage altogether.

Quality of Positive.—The question of the gradation of the coloured positive to be copied is one of great importance, just as important as that of the negative in ordinary photographic work. "Uto" emulsion has its scale of gradation just as any other printing-out emulsion has, and although the gradation may be modified to some extent, it cannot be hoped in the near future to make it suitable for other than coloured positives of medium gradation. Positives showing excessive contrasts, not of colour, but of light and shade, just like excessively hard negatives in ordinary work, are the most difficult to reproduce, as the details in the lights have finished printing and begin to flatten down before the light has been able to work through and differentiate the colours in the deep shadows. This difficulty, however, may be got over by giving the subject photographed suitable lighting and exposure. By the local application of matt varnish a too hard positive may be improved. What has been said refers only to contrasts of light and shade; the colours can never be too contrasty or brilliant, they are always toned down in the finished print.

Coating the Paper.—This had formerly to be done on the plate-coating machine on sheets of plate glass upon which the paper had been stretched. There was a difficulty in obtaining a regular and sufficiently thick coating of collodion on the paper-coating machine. I have now, however, been able to adjust the emulsion so that it may be coated direct upon a paper-coating machine of somewhat modified construction.

Regular coating of exact thickness is a matter of the utmost importance. Too thin coating will give a flat picture, too thick coating a harsh image with little detail, especially in the shadows, and in addition requires considerably longer to print. The coating should not be thicker than is necessary to yield a fairly deep black in the deepest shadows. I was at one time of opinion that a very thick coating would be preferable for printing Autochrome plates, but this is not the case; it might perhaps be so if the emulsion could be made considerably more rapid at the same time.

Printing.—The time of printing has been somewhat reduced. For ordinary window transparencies, about a quarter of an hour; for Autochromes, from one to two hours in full summer sun. In course of time it may be possible to improve the sensitiveness. It would be a great advantage in many ways. The "Uto" emulsion follows the same law as ordinary silver haloid emulsion does, the more rapid the flatter the scale of gradation, and *vice versa.* At present the scale of gradation is rather too steep, and will be improved by increasing the rapidity. Unfortunately, one of the dyes employed in the emulsion refuses for the present to have its sensitiveness further increased, so that the sensitiveness of the other two dyes has to be reduced to correspond, otherwise it would be an easy matter to obtain a four-fold speed.

The printing frame has to be continually under observation towards the close of the printing. A compromise may have to be made between the high-lights and the shadows. It is better, as a rule, to consider the high-lights primarily, especially if they represent any large proportion of the surface of the positive

Considerable improvement has been made in the purity of the whites obtained, but there is still room for further improvement, which will no doubt come in course of time. Of course, the ground tint must be taken into account in judging the best time to take the print out of the frame.

Printing Frame for Autochrome Plates.—This frame, with inclined mirrors, was described in the "B. J." last summer. It has proved of excellent service in reducing the time of printing and the quality of the result, especially the brilliancy of the colours.

Last year the Autochrome plates would not stand copying in this printing frame on account of the great heat developed. The varnish recommended by Lumière melted and stuck to the paper, so I had to resort to printing from unvarnished plates.

This year I have noticed a remarkable difference in the quality of the plates, as compared with those of last year. On copying in the sun, even without employing the special printing frame, I noticed that the colours in the plate began to disappear. At first I attributed this to bleaching, but I found afterwards that it was due to the melting of the varnish in which the starch granules are embedded; thus, of course, mixing up the colours, and yielding ultimately a positive in black and white. I have obtained exactly the same result by heating an Autochrome positive over a gas stove. It is evident that Lumière now employs a varnish with a much lower melting-point than he did last year.

In order to overcome this difficulty, I was obliged to resort to a cooling arrangement in connection with the printing-frame. The alum trough did not prove satisfactory, so I was led to introduce a tube along the inner edge of the frame connected with a water-tank and delivering a spray of water upon the cover-glass of the printing frame. This arrangement answers admirably, and I have not been able to detect any appreciable reduction in the intensity of the colours in the plates after printing many times over.

The patent application for the printing frame has passed the German patent examination, and corresponding applications have been filed in England and other countries.

Fixing the Dyes.—In this direction, also, I have made important advances. The first step necessary is to wash out the sensitisers. I have found that the class of sensitisers we employ are more thoroughly eliminated by means of vegetable oils than by benzole, etc., as formerly recommended. Mixtures of oil and benzole are best, the benzole being used simply to thin down the oil. The elimination of the sensitisers has been rendered more easy and thorough by means of the already mentioned ingredients added to the emulsion, which, while helping to bind the sensitisers, allow also of an easier diffusion of the sensitisers into the oil bath.

After the sensitisers have been washed out thoroughly, preferably in two or three changes of oil (which baths may, of course, be used over and over again), the sensitiveness of the dyes has been materially decreased, and the treated prints are much more stable than those fixed according to our previous instructions. They may, however, be rendered still more permanent by treatment with a special varnish.

The basic dyes have always presented great difficulty in rendering them permanent, and this difficulty is increased in the case of collodion films where the usual mordants cannot be applied.

I have been able to find certain chemicals, however, which have the property of fixing the basic dyes employed in "Uto" emulsion, and which are available for collodion films. They may be employed either in a bath or as a varnish.

Varnishing.—I prefer to employ the fixing agents as ingredients of a varnish, and to have this supplied as a glossy or matt varnish, so that it will not be necessary to manufacture two qualities of paper. Paper with a glossy surface is always preferable for printing, as it is more sensitive and purer whites can be obtained.

Perfume.—It is rather a pity that the sense of smell seems to be so very strongly developed in colour-photographers. I have been told by more than one excellent worker that they would never be able to touch "Uto" on account of the detestable odour of anisol. I think I may report progress, and offer a gleam of hope even to such sensitive natures. I will not say that they shall have an odourless "Uto," but it will be possible to modify and improve it to a considerable extent; indeed, it is not altogether improbable that in course of time a specially perfumed brand may be put on the market for the special use of lady colour-photographers; of course, at an enhanced price, as perfumery is an expensive class of goods. Dr. J. H. Smith.

ON THE PREPARATION OF COPIES OF SCREEN-PLATE TRANSPARENCIES.

[The following is the first part of a communication to the "Zeitschrift für Reproduktionstechnik," in which the authors, it will be seen, confirm the conclusions of Dr. C. E. K. Mees as to the optical conditions involved in copying from a screen-plate positive or negative on to another sensitive plate.—Eds. "Colour Photography" Supplement.]

Great as has been the interest in the Autochrome starch-grain screen-plates, their importance is found to be multiplied very many times the moment a method is actually available for easily and satisfactorily reproducing the results upon paper. In the meantime, the production of full-tone negatives from screen-plate transparencies is a subject of much interest both in regard to the Autochrome plate and the competitors of it which are announced to appear on the market. These latter, on account of their geometrical structure, should better lend themselves to the production of a full-tone set of negatives than does a plate of quite irregular grain, such as the Autochrome. We may first consider the plates of simple linear formation. Even if the near future does not provide us with a process of making paper prints from such plates, yet the means of reproducing from such plates will play an important part in "process" technique.

With a line screen-plate, scattering (as with the Autochrome plate) takes place only very slightly or not at all, and in the reproduction of one plate from another the crossing of the screen-lines of the negative with those of the positive has to be considered. Whilst the filter-film of the Autochrome consists of a casual mixture of three differently coloured constituents, all the linear screen-plates carry a series of filters, which is repeated over and over again on the plate with more or less complete uniformity.

In the communication which follows we have endeavoured to give a detailed representation of the processes which come into play in the printing of one linear screen-plate from another. This we have done in the theoretical way by a number of diagrams, and in practice have obtained results which confirm the theoretical conclusions. Our experiments cannot extend to the innumerable colours of Nature and their different intensities; we have been compelled to select certain characteristic colours, and to make these selected colours equal as regards intensity. The results obtained under these given conditions permit of definite conclusions being drawn in one direction or another.

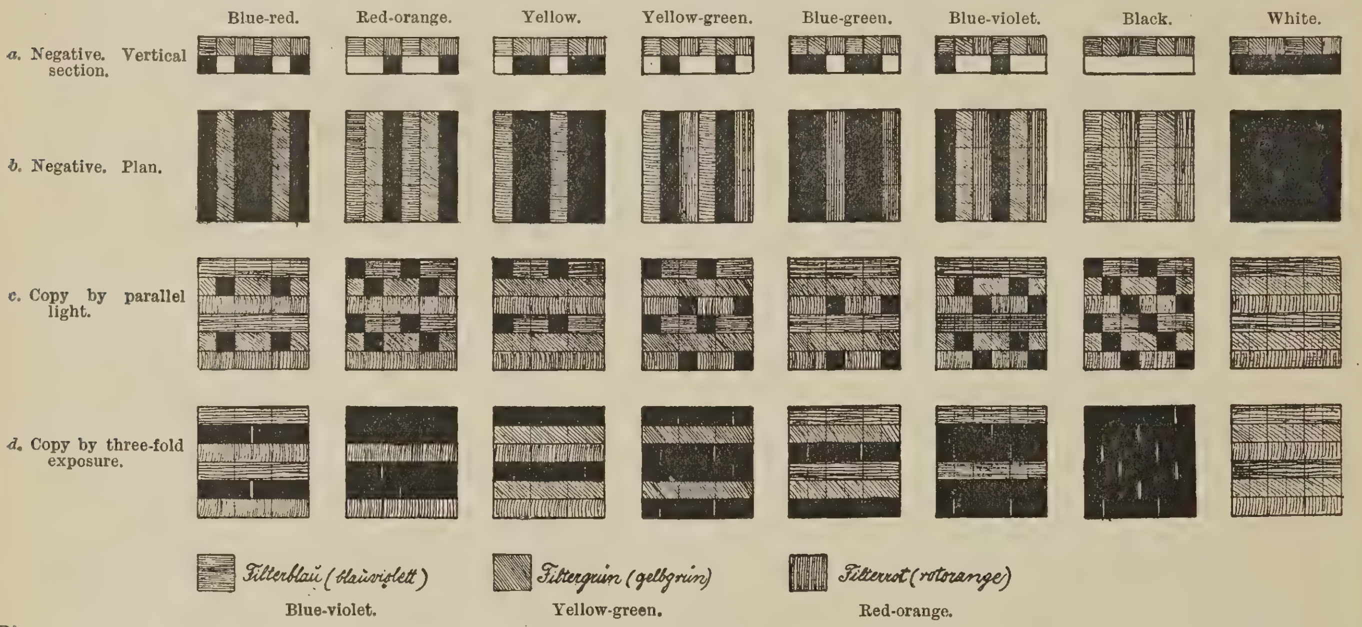

Fig. 1.

The operation of printing from a linear screen-plate on to another laid on it with the lines crossing at right angles is represented in Fig. 1. The original in this case is a colour chart of pure colours which contains, in addition to white and black, bluish-red, red-orange, yellow, yellow-green, blue-green and blue-violet. We have thus six colour tones which are so chosen that they divide the visible spectrum uniformly. Of these the red-orange, yellow-green, and blue-violet correspond to the filter-colour triad of the screen-plate, whilst the remaining three—blue-red (pink), yellow, and blue-green—represent their complementaries. Compared with the spectrum colours, five are seen to be the same, namely, the blue-violet, blue-green, yellow-green, yellow, and red, corresponding to a division of the spectrum at the wave-lengths 460, 490, 530, 570, and 600. Whilst there is no spectral colour corresponding to a bluish-red, the latter is matched by mixtures of lights of about wave-lengths 460 and 600. We consider it advisable, in experiments in three-colour photography, to describe the "nuances" of the respective colours as precisely as possible, and then, if spectral colours cannot be named as exact equivalents, to give an indication in terms of wave-lengths. Thus, if in the following there is occasion to refer to blue-green, it is understood that the reference is to a colour corresponding with that of wave-length 490.

These colours should be reproduced by aid of a screen-plate containing the colour lines blue-violet, yellow-green, and red-orange. (In the Warner-Powrie plate the sequence of the colours is blue, green, blue, red, blue, green, and so on, a difference which, for theoretical purposes, is of no importance.) In Fig. 1 we first see (a) how the separate colours are reproduced in the screen-plate negative. Each colour of the original renders developable those parts of the silver haloid which lie behind those filter-lines (exposure is, of course, made through the filter-film, as in the Autochrome process), which transmits the rays emanating from the colour original. The negative thus reproduces each colour by its complementary, bluish-red as green, yellow as blue, blue-green as red, black as white, white as black, whilst red-orange appears as blue-green (a mixture of the blue and green of the filters), yellow-green as bluish red (mixture of the blue and red of the filters), and blue-violet as yellow (mixture of red and green of the filters), according to the rules of the colour mixtures. In Fig. 1, *a* represents diagrammatically a vertical section through the filter and emulsion film of the negative. We thus obtain a negative in complementary colours (corresponding to the diagram Fig. 1 *b* of the appearance of transmitted light), and we have now to prepare a picture in correct colours by contact printing. The production of the positive picture is dependent on the character of the filters in the negative and positive plates, as also upon the conditions in the printing process. Quite distinctly different results are obtained according to the choice of these latter, the chief varieties of which we must consider at some length, as they are of vital importance. They are: (1) printing in parallel light, (2) printing with several light sources.

Printing in Parallel Light.

Parallel light may be obtained in several different ways. If, for example, a source of light be placed at the focus of a condenser or mirror, both optical systems will then give parallel rays of light. A camera directed towards a white sky will also supply rays of light which are sufficiently parallel. Even when the source of light is a point, the rays which are allowed to fall on the printing-frame will be practically parallel if the distance from frame to light is great in comparison with the diameter of the printing surface; even the marginal rays will fall upon the frame at a very small angle.

The lines of the screen of the (complementary) negative and those of the "copying" plate cross at an angle of 90 degrees. The more or less parallel rays penetrate the clear filter-lines of the negative in straight lines approximately at right angles to the surface of the negative. The green filter-lines allow green rays to pass; these meet the second filter-film, and can penetrate only to those parts of the sensitive film in which are the green lines of the filter-film. Thus, colour rays will reach the sensitive film of the printing-plate only where lines of the same colour coincide in the two filter-films. There is thus formed on the print obtained (in parallel light) through the crossed screens an image which is made up more or less completely of rectangular or square areas,[1] being composed of silver deposit which extinguish parts of the coloured filter and allow other colours to be visible, thus producing an image in colours. Fig. 1 *c* is a representation of this kind of printing process. The drawing shows, without further explanation, that this method of printing produces a relatively small decrease in the minimum transparency of the colour filter-plates,[2] but that, on the other hand, only colours of relatively small intensity are produced. The contrast between white and black is not as great, since black allows two-thirds of the white light to pass, and within these limits all colours are formed in their various intensities. To give one example:—

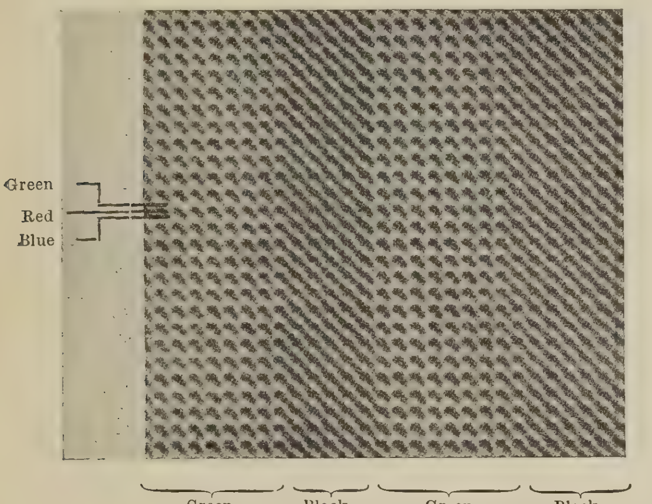

Fig. 2.

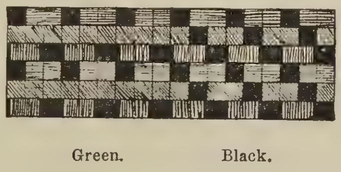

Fig. 3.

White consists of:

3 Blue-violet + 3 yellow-green + 3 red-orange.

Yellow-green consists of:

2 Blue-violet + 3 yellow-green + 2 red-orange.

The predominance of green is thus caused by the reduction of blue and the red by a third of their value. Such relative numbers obtain in the reproduction of all pure colours, and can easily be understood from the diagram Fig. 1 *c*.

These theoretical conclusions possess little value if their correctness does not admit of practical verification. In carrying out experiments for this purpose the material used was the linear celluloid screen-film of the Neue Photographische Gesellschaft, of Berlin, which was suitable on account of its relative coarse structure (6 to 7 lines per millimetre); slight enlargement was thus sufficient to produce a readily recognisable print of the structure. A negative was made from a glass positive obtained with the crossed screens, as above described, using parallel light and a panchromatic plate. This negative scarcely shows any trace of the line structure of the film. It is black and white, and gives a negative image of the silver deposits of the colours in the linear screen-film as square (Fig. 1 *c*). Enlarged in an enlarging apparatus of the ordinary kind, a result is obtained which clearly shows the formation of the silver deposits in the line screen positive accompanied by the disturbing colour filter lines. Fig. 2 shows such an (five-times) enlargement. It is part of a spectrum exposure which was made, and consists of several superimposed spectra, the green portions divided by black particles. The disposition of the several squares to each other corresponds almost completely with the theoretical deductions, and we have attempted in Fig. 3 to represent the grouping of relative sizes of the portions of the enlargement. Comparison of this diagram with that of Fig. 1 *c* (green and black) shows the agreement between the two as regards the size of the silver deposits lying in the red-filter lines. These are actually somewhat larger than the theory requires, the reason for which is to be sought in the fact that in the material employed the red-filter lines, as compared with the green and blue, are made too bright, probably to assist the lesser red-sensitiveness of the emulsion. Further, the filter-film is not gray, as a whole, but appears of a red tinge.

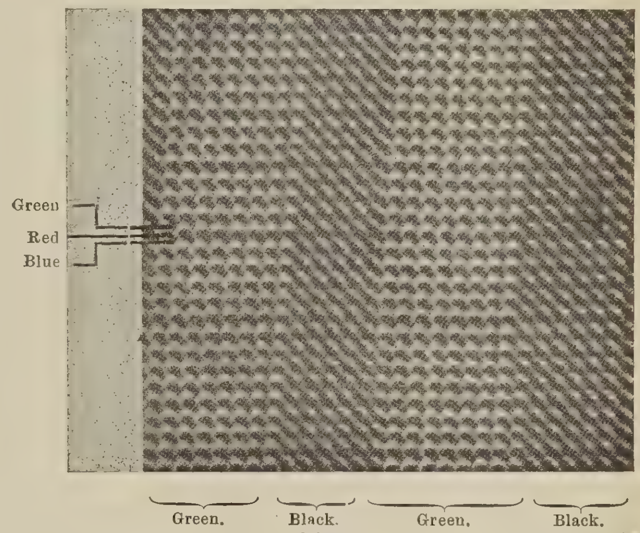

Fig. 4.

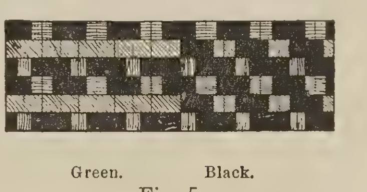

Fig. 5.

2.—Printing with Several Sources of Light.

As has been shown in the foregoing section, on printing by parallel light with the screens crossed only colours of less intensity are produced, as the several colours are represented only by a relatively slight excess of the filter screen-lines which respectively give rise to each. Measures are, therefore, taken to enhance the colour contrasts. It was not difficult to attain this in the printing process. First, Warner and Powrie have suggested the method according to which it is possible to displace the separate square deposits of silver in the direction of the filter-lines which are to be covered—that is, the lines which carry the colour which is to be cut out; that is to say, an elongated rectangle is formed from the more or less exactly-formed square. Such methods are of importance for the preparation of colour copies. If such rectangles are displaced from each other by their short sides, they cover the filter-line completely, and completely cut off the colour from that portion. In order to produce this side-way enlargement of the various rectangles, it is necessary that the light during the printing should fall not only perpendicularly, but also from the side. The light passing through the negative-film must spread in the positive-film lying under it in the direction of the lines of the positive. Many ways can be suggested of causing this spreading in the positive-film. We shall refer to the subject again in a later paper, and now will mention only three of the recommendations which have been made:—

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[1] The form of the silver deposit depends on the angle at which one set of lines crosses the others. The areas are rectangular only when the crossing is at 90 degs.

[2] "Phot. Chron.," 1908, No. 32, p. 193.

(a) Three appropriately placed sources of light may be used.

(b) A single source of light may be used, and a mirror placed at an angle on either side of the frame.

(c) The exposure may be made to one source of light, moving the printing-frame between each exposure.

Of these (c) is probably the simplest; (b), which is easily carried out, has the drawback that the reflected light is weaker than that falling direct on the plate. Moreover, in all cases the oblique light has to pass through a greater thickness of film, a fact which may be obviated by longer oblique exposure.

The most favourable case of printing with light coming from three sides is represented in Fig 1 *d*. The separate filter-lines of the print are completely covered, whilst previously only one-third of the respective colour was cut off. Prints made as represented as in Fig. 1 *d* are completely reversed versions of the negative represented by Fig. 1 *b*. The contrasts between black and white are here as great as can be obtained by the use of the materials. Those colours which correspond with the pure filter colours are formed of two black and one coloured line, since in every case two lines out of three are covered, whilst mixed colours show less black components. In order to appreciate the example previously selected, in relation to the present modified conditions, the latter may be conveniently expressed as follows:—

White consists of:
3 Blue-violet + 3 yellow-green + 3 red-orange.
Yellow-green consists of:
0 Blue-violet + 3 yellow-green + 0 red-orange.

We have prepared experimental plates made in accordance with this second suggested method of printing, the silver deposits being recorded and enlarged as before. Fig. 4 shows the same part of the spectrum exposure. A sharp distinction will be noticed between Figs. 2 and 4, since Fig. 4 shows, in accordance with the theoretical scheme of Fig. 1 *d*, a much stronger deposition of silver, which we have endeavoured to diagrammatise in Fig. 5. The rectangular silver image of the red filter-lines have spread out to such an extent that they almost join, whilst the deposit under the blue and green filter-lines are still too remote to correspond with a theoretical solution of complete colour reproduction. However, in this case also we shall find that the result of the experiment could hardly have been otherwise in view of the material operated upon for this purpose. We must apply our observations to the influence of a new but up to now neglected factor.

DR. E. STENGER.
F. LEIBER.

Correspondence.

*** *We do not undertake responsibility for the opinions expressed by our correspondents.*

*** *Correspondents should never write on both sides of the paper. No notice is taken of communications unless the names and addresses of the writers are given.*

THE AUTOCHROME PROCESS.

To the Editors.

Gentlemen,—I have made some very careful tests of the method of sulphide toning, given in your issue of August 7. In each case I gave the same exposure to two plates. I treated one according to the Lumière method and the other as recommended by M. Torchon. The colours of the two positives were entirely different. In no case were the colours I obtained by the Torchon method those of the landscape photographed.

On the other hand, it has proved in my practice very advantageous to use the bath of alum and bisulphite after the acid permanganate bath. It completely removes the stain frequently left by the permanganate and gives more transparent colours.

I have made tests also of the colours obtained, when ammonium persulphate was used in place of the acid permanganate bath. In this case the blues and greens were not correctly rendered.—Yours truly,

J. C. S.

Champéry.

[The sulphide toning method given by M. Torchon no doubt affects the colour owing to the deposit being brown. We do not see why the colour should be affected by the use of ammonium persulphate, but in any case we prefer the acid permanganate bath. We have also found a little bisulphite very effective as a clearing bath after the permanganate, but it has always appeared to us that an acid diamidophenol developer had quite as much effect.—EDS. "Colour Photography" Supplement.]

◆

THE "THAMES" COLOUR PLATE.—At the meeting of the London and Provincial Photographic Association, held on Thursday in last week, some finished results on the "Thames" plate were handed round. The results were certainly excellent. One in particular deserves to be mentioned: it was a picture of a greengrocer's shop front with the stock-in-trade exhibited therein. All the colours were beautifully rendered, and the shadows were particularly rich and good. The exposure given was sixteen seconds, with f/32, in diffused light. Thus it will be seen that the plate is a fairly fast one, due probably to the remarkable transparency of the dyes used in the making of the screen-plate. An unsensitised specimen of the latter was on view, and one was able to see that there was no opalescent effect in the "Thames," and details could be distinctly seen through it. It was stated that the new plate would be on sale in about a month, and that the price would be half-a-crown for four quarter-plates.

THE WARNER-POWRIE SCREEN-PLATE.—We learn that a modified form of screen-plate is being adopted in the Warner-Powrie process, the fineness of which, to judge from a sample before us, practically brings the "structure" of the pictures to continuous tone. The filter plates, like those of 600 lines per inch already exhibited, are made from a 200-line grating or model, but by a modified method which gives a series of squares of two colours between each line, and moreover is carried out without registration. The result of the process is a screen of such fineness that it will stand magnification to about 150 diameters for lantern projection purposes, obviously more than sufficient to retain fine details. Moreover, the colours, again to judge from the specimen, are brighter and more transparent even than the previous make of screen-plate. The process of manufacture, which secures a distribution of the colour elements without gaps or overlap, and this without registration in printing, may be carried out on the machine already installed by Mr. Powrie in London for the linear-ruled plates (which may still have advantages for certain specific purposes) at an increased output. It is understood that the screen-plate in this modified form will shortly be in course of manufacture; its properties, even in comparison with its immediate predecessor, should certainly be held to justify the promoters in having waited for its completion.

No. 22. Vol. II. OCTOBER 2 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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A SIMPLE AUTOCHROME METHOD.

I think it will be most convenient to give first details of the method I propose, and to follow it with any comments. It will be seen that I aim at attaining exactitude in time for exposure and time for development by simple means; that a dark-room light is not required, merely a darkened room; and that fewer solutions are required than in the Lumière instructions, the intensifying and subsequent clearing being omitted. The Lumière formulæ are not departed from except for the first development The bottles of solution required are reduced to four—namely, first developer, reversing, second developer, and fixing; and, indeed, if the second developer is, as I advise, made up each time of using, only three bottles need be provided, instead of the eight of the original instructions.

Exposure.

This is gauged with the aid of an actinometer, namely, a Bee Meter, which must be fitted with the special Autochrome dial, as there is a radical difference in the calculation from an ordinary exposure. The light falling on the subject is tested; if in full sunlight expose the meter to the sun; if part sun and part shadow test both full sun and the light from sky with sun shaded from meter, and take the average to calculate with. The calculation is made exactly as with the ordinary meter; the plate speed for Autochrome plates, using the Autochrome light filter behind the lens, is 2. The front dial is revolved until the stop used is opposite 2, and then against the figure or space representing the light test there will be found the exposure to give.

If the light filter is fitted behind the lens, no allowance need be made in focussing, for the fact that the plate has to be placed in the dark slide with the glass side facing the lens.

One curious point must be remembered when using the special Autochrome meter. If the light is calculated as minutes (for interior work), and the exposure figure therefore read as minutes, it is necessary to calculate with a plate speed of 1 instead of 2.

It is possible that different batches of Autochrome plates may vary, and that a different speed number than 2 (perhaps higher) may be required.

First Development.

I advise the use of the Watkins concentrated time developer, not because it is better than other developers for the purpose, but because I know of no other way of attaining that exact adjustment of time for temperature which is essential for uniform results. This particular developer is provided with a temperature calculator encircling the bottle. It should be used double strength. Measure out 2 drams of the concentrated solution for each ounce of developer required, and fill up to the quantity with water. Add 5 minims of 10 per cent. bromide solution (½ grain bromide) for each ounce. The time of development for a temperature of 60 deg. is 3½ minutes, and if the indicator on the bottle is set to 3½, other times for other temperatures can be read off the scale. The plate is placed in the dish in the dark, the developer poured on, the dish covered over, and the light instantly turned up so as to set or notice the clock or watch for the time of starting development. A thermometer is consulted for the temperature, and care must be taken that the developer is made up from a jug of water which has been standing for some time in the room, so as to attain its temperature. When the time indicated by the thermo calculator on the bottle has elapsed, the light is turned down and the plate washed. The first washing and all subsequent treatment is conducted without removing the plate from the dish at all. This avoids handling the edges of the plate with warm fingers, a fruitful source of frilling. The surface of the plate must never, under any circumstances, be touched with a finger until it is finally dry and finished. A finger mark before exposure always shows in the final result.

First Washing.—Hold (in dark room light) under a very gentle flow from the tap for 20 seconds, keeping the plate in the dish. If the tap water is of different temperature to the room, wash from the stock jug.

Reversing Solution.

Potassium permanganate	17 grains.
Sulphuric acid	1½ drams.
Water	20 ounces.

Pour sufficient of this in (in the dark), and as soon as the plate is covered full daylight can be used for this and all future treatment. Leave in, rocking the dish, for 3 minutes. The reversing solution has not good keeping qualities, and should be made afresh after a week.

Second Washing.—As before for 40 seconds.

Exposure to Light.

Expose to daylight for at least as long as the actinometer takes to attain full tint. If the work has to be done at night, burn a foot of magnesium ribbon within a few inches of the plate—held almost upright in its dish.

Second Development.

Sodium sulphite	24 grains.
Diamidophenol	4 grains.
Water	2 ounces.

This solution will not keep a day. I advise that this be made up each time just before commencing the first development. After the first time of weighing, the quantities of the solids can be guessed near enough, as the exact activity of the developer is unimportant, it being only necessary for it to act long enough to darken all the silver bromide left in the film. Develop for 3 minutes for 60 deg., longer development for colder temperatures as indicated on scale.

Third Washing.—As before for 40 seconds.

Clearing Solution.

Reversing solution	½ dram.
Water	3 ounces.

This should be poured on for 10 seconds, unless it is desirable to reduce the general density, when it may be left in for 20 to 40 seconds. It acts as a weak reducer.

Fourth Washing.—As before for 30 seconds.

Fixing.

A fixing bath is made up as follows:—

Hypo	3 ounces.
Potassium metabisulphite	1 dram.
Water	20 ounces.

Sufficient of this is poured on the plate (in the dish as before), and allowed to act for two minutes.

Final Washing.—Still leaving the plate in the dish, it is placed under a gentle drip from the tap for five minutes, taking care that the water falls just within the spout of the dish, and not direct on the plate, or blisters will result. The plate is then placed on edge to dry. It may be varnished with a celluloid or benzole (not spirit) varnish, but this is more often omitted.

Care must be taken that all the solutions are of the same temperature, for if there is a considerable difference frilling will result. I have just lost one pair of plates by using the reversing solution soon after mixing when still warm from the dilution of the sulphuric acid. For the same reason the fixing solution being icy cold when fresh mixed, should not be used for a time.

Comments on the Methods.

In making an Autochrome, it must be remembered that the exact time of exposure and development of the first image is all important, for there is no room to get equally good results (as with ordinary negatives) with varying exposure. The reason is that the whole of the film of silver salts is used up in either the first image (the negative) or the second. If too much is used to make the first, there is not enough thickness left for the final image; and if the first image is under-exposed or under-developed, there will be too much of the final image, which will be too dense all over. In fact, the two images may be regarded as a coin and the die from which it is stamped, the two fitting exactly into each other, but the one dissolved away before completion.

In using an actinometer to gauge this exact exposure, it was at first discovered that it did not appear to give the right ratio between good and poor (as interior) lights. In fact, different speed numbers had to be used indoors and outdoors.

This was at first put down to a want of orthochromatic quality in the meter paper; but I soon pointed out that the error was in the wrong direction for this to be the fact, for the meter paper already darkened too quickly (in proportion for the right exposure) in a feeble or yellow light. I traced the discrepancy to a failure in the usual law that intensity of light and duration of exposure are inversely proportionate, which law is the basis of the usual calculating scales of a meter. Abney had long ago pointed out that with feeble light this law sometimes failed, and the cutting down of light by the starch grains and the colour filter has the effect with Autochromes. To overcome this, I found it best to make a new calculating front to the Bee meter, which makes the necessary correction, and permits the same speed number to be used in and out of doors.

Messrs. Lumière's earliest instructions made a great point of exactitude of time for the first development, and laid down 2½ minutes as an unalterable time. Here was a great defect, for, although they mentioned a standard temperature, it is practically impossible to develop at a uniform temperature all the year round, and a variation of time to allow for change of temperature is practically indispensable. My own experience was that the 2½ minutes for the pyro-ammonia developer had to be increased to as much as 5 minutes in the winter.

In Messrs. Lumière's new and modified instructions they evidently attempt to compensate for changes of temperature by my method of an observation of the time of appearance. But, unfortunately, they depart from what is a necessity in the factorial method—namely, a developer of constant composition. They evidently attempt also to compensate for errors of exposure by variations in the amount of alkali added. But, as an observation of the time of appearance gives no clue as to whether a variation of such time is due to temperature or to wrongful exposure, I regard their new method as radically unsound. It would be sound to use the factorial plan with a constant developer, and rely upon other means to keep exposure uniform. I prefer, however, to dispense with any need to examine the image by dark-room light, and allow for variations of temperature by a thermo scale, securing uniformity of exposure by the use of an actinometer exposure meter in the manner I have detailed.

I consider that unless fairly large window transparencies are attempted a stereoscopic slide is by far the best outcome of the Autochrome process. It is a completely satisfying finished production, about which no one remarks, "I suppose you will get prints from this," and is also in a convenient form to use as a lantern slide if desired.

In my own practice I use two 3¼ by 3¼ plates side by side in a special carrier to fit my 7½ by 5 camera, which, of course, is fitted with a pair of lenses, a pair of light filters, and a division in the camera. A quarter-inch strip is cut from the outside edge of each plate, so that the images come the right distance apart when reversed and mounted on a glass plate for the stereoscope. Or the miniature stereoscopic camera of Jules Richard can be adopted.

ALFRED WATKINS.

COLOUR PRINTS FROM AUTOCHROMES.—Since our recent mention of the three-colour carbon prints from Autochrome originals now being shown in the Royal Photographic Society's exhibition, the exhibitor, Mr. W. Rayner, of "Arundel," Uxbridge, W., has shown us some further examples of his work, and has sent us a list of prices at which he is prepared to undertake the making of such reproductions on paper of Autochrome originals. The charges are certainly moderate—e.g., 6s. for one print from a ¼-plate Autochrome, or 25s. for half a dozen. Mr. Rayner will also prepare a set of negatives for printing in a subtractive process at a price of 5s., in a ¼-plate size. He also offers to make or develop Autochromes, and to quote for photo-mechanical reproductions of Autochromes as 'Xmas cards, etc.

AUTOCHROME ITEMS.

Notes on Autochrome Manipulation.

WHEN commencing my trials of the Autochrome plate (writes M. Chabaseau in "La Photographie des Couleurs") one of the first things which it occurred to me to test was the use of a piece of white card for backing the plate in place of the black material usually advised. There was certainly the likelihood of halation being produced by the greater reflecting power of the white card, but, on the other hand, I was hopeful of being able to reduce the exposure owing to this very reflecting action. However, it is sufficient to say that while no halation or fog is produced there is no possibility of using the method for reducing the time of exposure. This was ascertained by backing half of the plate with black, and the other half with white, card. The two halves were quite identical, and the only satisfaction from the experiment is that, when no other is available, white card may be employed for the protection of the film side of the plate.

In developing the Autochromes I have used for some weeks the recent formula of MM. Lumière. The addition of sulphite of soda causes the bath to discolour very slowly and to become turbid only at the end of about half an hour, whereas the previous developer was strongly discoloured after being in use one minute. Yet the system of timing now advised by the makers seems to be really an unnecessary refinement, because the whole of the development of the Autochrome can be readily followed by inspection. The development should be commenced with a solution weak in alkali, and the operation carried out as for an ordinary negative, save for the fact that one does not hold it up to the light to look at it, but judges of the image as it lies in the dish.

I advise the invariable use of a 1 per cent. solution of chrome alum, employed for two or three minutes immediately after the reversal in the permanganate bath, on the ground that the subsequent processes of intensification, clearing, etc., may, if necessary, be prolonged without there being any reason to fear the frilling or softening of the film.

As regards the reversal alleged to take place when plates are exposed freely to light after reversal and before the second development, M. Chabaseau quotes the following experiment:—Exposure was made of two stereoscopic pictures on the same Autochrome plate. The whole plate was developed and reversed as usual, washed and dried in the dark, and then cut in half. One half was kept in the dark, the other was exposed to diffused daylight for half an hour, in bright June weather, gelatine side upwards. During this time it became grey. Then it and the half of the plate which had been stored in the dark were placed together in the re-developer, when it was found that, except for a slight difference in colour, the exposed plate being somewhat brownish, whilst the non-exposed plate was black, there was no difference between them, and when the after operations had been carried to a conclusion the two results were identical. The author confirmed this test by a similar experiment which had a like result, and thus concludes that the tourist may safely perform the first development and the reversal whilst on his travels, postponing the after operations of re-development, intensification, etc., until his return, and in doing this he need not hesitate to wash and dry the plate in full daylight.

The tourist also may find it convenient to replace the liquid ammonia of the developer by the more conveniently carried solid ammonium carbonate, the equivalent of which with regard to liquid ammonia is thus stated by the writer:—Ten ccs. of ammonia of 20 deg. Beaumé is equal to 8 or 9 gms. of carbonate. Although the carbonate bought at a chemist's is not of invariable strength, yet it is sufficiently so for developing the Autochrome plate by inspection.

As regards intensification and the intensifier, M. Chabaseau is in agreement with the general conclusion that in the case of plates which have not been intensified there is no need to use a fixing bath. He, however, prefers to fix plates which are intended for lantern projection, owing to the alleged greater opacity of these latter if not treated in a fixing bath.

The fungoid growth, which makes itself evident in the F solution of pyro and citric acid, may be avoided by the following modification in the formula: 5 gms. of salicylic acid are dissolved in 100 ccs. of hot water, and the following solution then added:—

Pyro	3 gms.
Citric acid	3 gms.
Distilled water	900 ccs.

The majority of negatives over-exposed or over-developed require a considerable degree of intensification. An under-exposed plate, or one which has not been much developed, requires only slight intensification, just enough to give pluck to the colours. Thirty or forty seconds' immersion in the bath is quite enough in most cases; a longer period only destroys the colour tones and gives a choked-up appearance to the transparency.

In regard to the cause of many defects in the Autochrome process, the weakening of the image in the fixing bath, M. Chabaseau, after referring to Namias' explanation of this trouble—namely, the formation of manganese dioxide in the film and the formation thereby of a soluble silver sulphate—objects to the remedy for this (oxalic acid) prescribed by Namias, since a deposit of oxalate of lime is thereby frequently formed on the plate, even when the precaution is taken to bathe the plate for some minutes in warm water before applying the oxalic acid solution. A preferable plan, therefore, according to the writer, is to intensify somewhat more than necessary, and, after clearing in the neutral permanganate solution, to plunge the plate, for 30 seconds only, in the bisulphite-hypo solution. This operation (improperly named fixing, since there is no silver salt to remove) is very necessary when the plate has been in the so-called clearing bath. Of two plates of the same subject (a stereoscopic pair), one treated in the oxidising bath but not fixed, and the other treated with bisulphite after the permanganate, it will be found that the colours of this latter plate contrast in an astonishing manner with the saddened tones of the first. Lastly, the final traces of dichroic fog only disappear in the mixture of hypo and bisulphite.

The author finds that very little advantage is gained by varnishing the Autochrome so far as its appearance is concerned, but recommends varnishing as an invariable practice as a means of protection.

The "Inversol" Reversing Bath.

In a supplementary note M. Chabaseau announces that a reversing preparation has been introduced by him under the name "Inversol." It is a solid body which dissolves immediately in ordinary water (it is not necessary to employ distilled water), and has a tanning action upon the Autochrome film, in addition to its solvent properties on the silver image. It keeps indefinitely in the dry state, whilst a solution may be used for at least some weeks, filtering off any deposit which may precipitate. The solution can also be used as the clearing bath E of the Lumière instructions.

Autochromes by Artificial Light.

M. René Locquin, commenting upon the loss in colour effect which takes place when an Autochrome is viewed by artificial light, recommends the use of a blue screen between the Autochrome and the source of light in order to cut out the excess of yellow rays in the latter. In choosing a glass for this purpose its depth and colour should be such that when held up to the source of light the glass itself appears without colour—that is to say, its coloration is exactly complementary to that of the flame or mantle. M. Locquin has used for this purpose the bluish-green glasses supplied by dealers for use as focussing screens for use in ordinary photography.

Intensification of Autochromes.

A French worker has recently suggested the substitution of Monkhoven's silver cyanide intensifier for the pyro-silver formula recommended by Messrs. Lumière for the Autochrome plates. This advice we certainly cannot endorse, for the Monkhoven method gives results that are perhaps the least permanent of any produced by the various mercury processes. For our own part, we see no valid objection to the pyro-silver intensifier, certainly nothing that would warrant its rejection for such an intensifier as silver cyanide. If, however, another intensifier is really required, probably mercury and ferrous oxalate is the best to employ. Considering the cost and trouble involved in making Autochromes, and the fact that the result cannot be reproduced, it seems to us that even a suspicion of impermanence is enough to condemn any variation. For our own part, we fail to understand the object of the variations that are so frequently proposed in the Autochrome process. When all is said and done, the actual manipulation is very simple and very rapid, while the results are worth a considerably greater expenditure of time and trouble.

The Lumière Co. are now issuing a leaflet with the latest instructions for the use of the Autochrome plates, these being identical with those we published in our Colour Supplement of June 5. It will be remembered that these new instructions give a method of compensating for wrong exposure, the procedure adopted being decided in accordance with the time of first appearance of the image. The table of times, with instructions for modifying the development, can now be obtained on transparent paper arranged for hanging in front of the dark-room lamp, which is assumed to be fitted with the Virida paper light filters. Another innovation is marking each box of plates with the date before which they should be used. Apparently the time allowed is about three months, but the warning is supplemented by a note to the effect that the time given represents the minimum limit within which the plates retain their qualities unimpaired, if protected from heat and damp. It is said that they will yield excellent results several weeks after the indicated limit. Our recent experiences with Autochrome plates show that the plates have improved wonderfully compared with those of last year. The most recent batch that we used gave spotless results, and also showed no sign of frilling, though we handled them as freely as ordinary negatives and took no precautions whatever.

ON THE PREPARATION OF COPIES OF SCREEN-PLATE TRANSPARENCIES.

[The following is the second part of a communication to the "Zeitschrift für Reproduktionstechnik," in which the authors, it will be seen, confirm the conclusions of Dr. C. E. K. Mees as to the optical conditions involved in copying from a screen plate positive or negative on to another sensitive plate. The present contribution supplies the mathematical rules for the angling and illumination of a screen-plate colour transparency when printing another from it.—Eds. "Colour Photography" Supplement.]

It may be mentioned here that the copying of one Autochrome on another can be done with success, as attested by various workers. The arrangement of the films in the printing-frame is as follows:—The negative or positive to be reproduced is first inserted, glass side outwards, and the sensitive Autochrome plate on which the copy is to be made next placed in position, also glass side outwards, i.e., next the film of the negative or positive. The light thus passes first through the glass and then through the filter-film of the new plate in order to reach the sensitive emulsion. It is easy to see that the starch-grains of the sensitive plate should be one-third the size of those in the plate to be reproduced, that is, assuming that the filter elements are regularly distributed. In the case of irregular distribution the starch-grains should then be smaller still in the second plate in order to obtain the best results. In practice, however, it is found that satisfactory reproduction results when using a plate of exactly the same kind as that employed for the original, in consequence of the scattering of light from the translucent (not transparent) filter elements.

The present is perhaps a suitable juncture at which to make a note as to the transparency of screen-plate copies. One of us has lately measured the transparency of some screen-plates. An unexposed and fixed plate which passes 10 per cent. of the light falling on it compares with a screen-plate copy as follows:—Through crossing of the screen-lines in the parts of pure colour 7/9 × 10 up to 1/3 × 10 per cent. of light is allowed to pass—that is to say, from 8 to 4 per cent., according as parallel light is used or the special means above mentioned taken.

In the printing of one screen-plate from another with several sources of light in the manner above suggested the mode of preparation of the screen-plate is not without its effect, inasmuch as results of the printing process are not the same if the colour-filter is also the support of the emulsion, or if the colour-filter is itself supported on a glass plate. Thus the Krayn film and the Warner-Powrie plate differ in this respect, and we will proceed to point out the differences which result from characteristics such as these in our materials as regards their relation to the breadth and thickness of the filter-line.

There are four cases to be distinguished:—

I. The filter is also the emulsion support; the filter-lines are broader than they are thick.

II. The filter is also the emulsion support; the filter-lines are thicker than they are broad.

III. The filter is supported; the filter-lines are broader than they are thick.

IV. The filter is supported; the filter-lines are thicker than they are broad.

It will be understood that the breadth and thickness of the filter-lines run into very small dimensions, e.g., the Krayn filter has its lines about .14 mm. broad and .13 mm. thick. The Warner-Powrie screens are only 1-100th of a mm. thick, and run to 25 per mm.—that is, the Krayn screen falls between Classes I. and II. above, and the Warner-Powrie in Class III.

The following drawings, Figs. 6 to 9, will further explain what takes place when a multiple source of light is used for printing from one screen-plate on to another. N is the negative film, K is the surface of the sensitive plate, G the glass plate which carries the film, L the source of light used in the different positions. The film of the negative and printing surface is shown in vertical section. The plates being placed on each other so that the filter lines cross, it will be understood that in the drawing those of the negative run at right-angles to the plane of the paper from back to front, those of the printing plate from right to left. Thus the negative lines are seen in section whilst the printing surface shows only one line. In regard to the negative film three filter lines are completely shown in section: the two outer of these are supposed to be covered with a silver deposit, and, as they are different in colour from the intervening lines, and therefore transmit no actinic light, are represented as black. The negative corresponding to Fig. 1b (blue-red) can be shown, and from the corresponding print, Fig. 1d, it can be seen that the open green line of the negative should completely cover the green line in the positive. In tracing the course of the rays from a multiple source of light we must assume that the filter line in the printing film is of the same colour as the open filter line in the negative film. This open filter line being in the crossed position shown, it is necessary to allow light to reach the threefold line surface of the printing film, in order to render the sensitive surface developable from *a* to *a*. If two sources of light are placed in the positions L, and their rays directed on to the surface *a a*, the rays will meet the surface only at the limiting point *a*, and only these points, therefore, will be rendered developable. A light source, the rays from which meet the surface more or less perpendicularly—that is to say, in the direction of the point L_3—illuminates the region of the surface *a a* to be exposed, marked l_3, which region is shorter the greater the distance of the source of light L_3.*

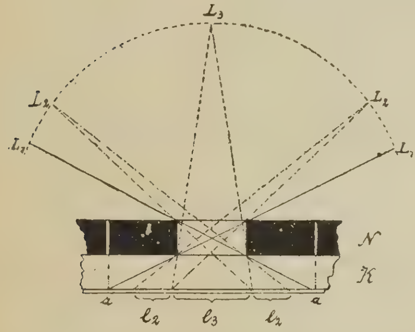

Fig. 6.

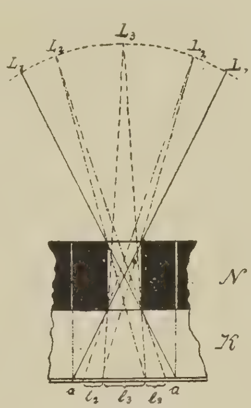

Fig. 7.

The effect of the sources of light placed to the side must complete that of the central light source L_3, and this condition fixes the sideway position of these sources of light, the rays from which meet the surface *a a* in the region L_2. The conditions represented in the diagram are really more favourable than those which naturally occur, since the exposed portions l_2, l_3, l_2 of *a a* are shorter the further the distance from the source of light: the direct rays from the latter form a smaller angle at an increased distance from the light source on angling of the open filter lines. So much for the explanation of the construction of Figs. 6 to 9, which correspond with the four possible cases enumerated in the preceding article. We may next compare the effect of the three sources of light on the surface *a a*, and in doing so we must not lose sight of the fact that the above diagrams relate only to a system of blue-green-red lines. But it can be seen that in the case of screen-plates in which the filter film is not mounted on its own support (I. II.) it is difficult, or even impossible, to expose the total surface of *a a*, whilst in the case of screen-plates in which the filter elements are supported on a special plate (III. and IV.) the whole surface *a a* is readily acted upon by light when printing. Figs. 6 and 7 thus correspond completely to the practical example instanced in Figs. 4 and 5 of a case in which it was not possible to obtain a complete joining up of the filter lines not concerned in the building up of the colours. Such plates, or rather films, can easily be improved as regards printing by laying between the negative and the printing surface a colourless film, say of glass or celluloid, and in this way realising the conditions corresponding to III. and IV. (Figs. 8 and 9). It will thus be seen, without further illustration, that the filter lines should be appreciably wider than they are thick, in order that a certain sideway inspection of the pictures (inevitable almost when observing a print of any size) shall not give rise to disturbances in the colour effect—that is to say, that the eye shall not perceive any filter line except that which lies immediately behind the silver deposit produced in the first instance. If by such error of parallax a sight is obtained of filter elements lying on one side or the other of the silver deposit, errors of colour are, of course, produced (Fig. 10). Obviously the eye will not see the same colour when looking in the direction A that it does when looking from B. This defect is inherent in a greater or less degree to all screen-plate methods, since the screen of colour elements and the silver deposit do not lie in absolutely the same plane; but it may be mentioned that even in the case of colour plates of irregular filter grain these errors of parallax come in, but that in these cases the colours are not altered, but only darkened, and thereby weakened.

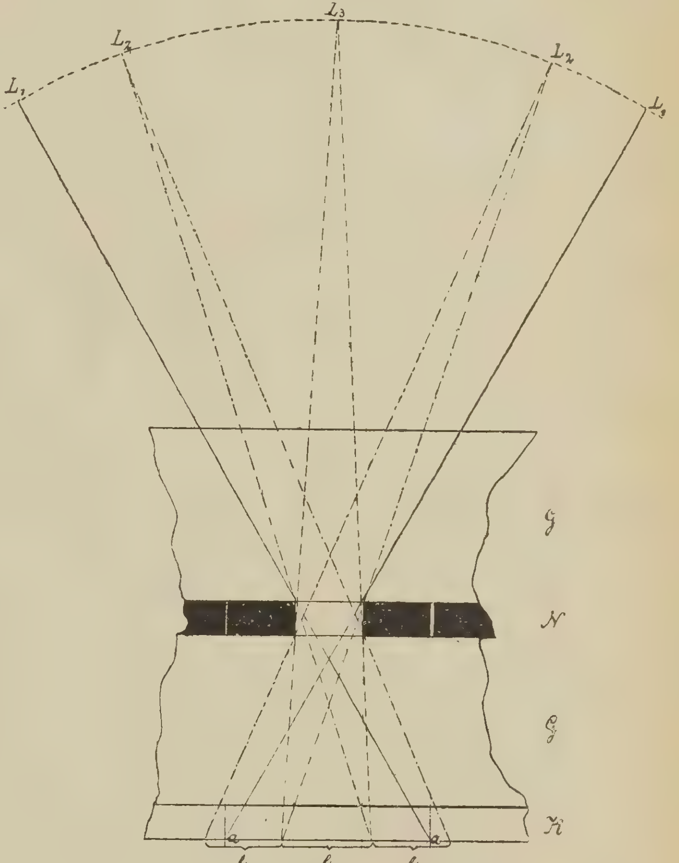

Fig. 8.

Our next problem is to fix the relative position of the several rays of light in relation to the thickness of the support and the width and thickness of the filter lines. The distance of the source of light may be taken as known, and we will assume it to be of 20, 50, or 100 cm. It will be seen from Fig. 11 that the proper distance of the light sources, L_3 and L_2, is dependent on the angle, E. As *a* is smaller in comparison with the distance of the source of light from *a*, the distance of the two sources of light from the printing surface can be taken as equal, although geometrically L_2 and L_3 lie on a circle drawn from D as centre. The triangle A B C is completely known, since we know the side *a*, the distance $b + c$, as also the enclosed right-angle. As the angle E, which is one of the angles of the right-angled triangle of which *e* is another angle, is, however, still greater than β, it follows that the angle *e* must be very small, since $E + e$ = one right-angle. This holds good for filter plates with their own or with inserted supports of the filter elements. Calculating in this manner, and assuming the insertion of an intermediate film of 1 or 2 mm. thickness, we have worked out the value of the angle e for the Warner-Powrie and Krayn filter plates. The following table gives the results which have been obtained graphically for the angle β: angle e is smaller than the difference between β and a right-angle.

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* Actually the distance of the source of light from the negative is infinitely great compared with the thickness of the filter film, whilst the angle of the rays of light from L_3 on the filter line is so small as to be practically parallel.

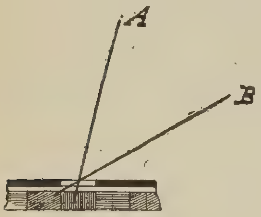

Fig. 10.

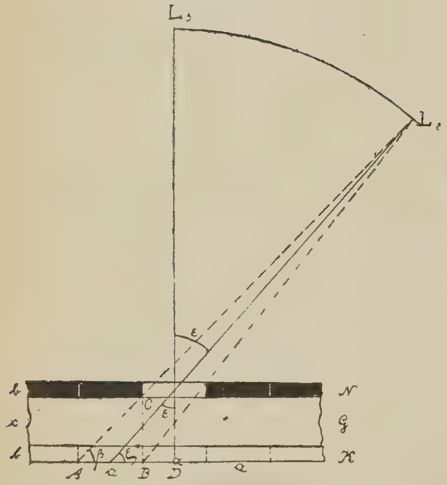

Fig. 11.

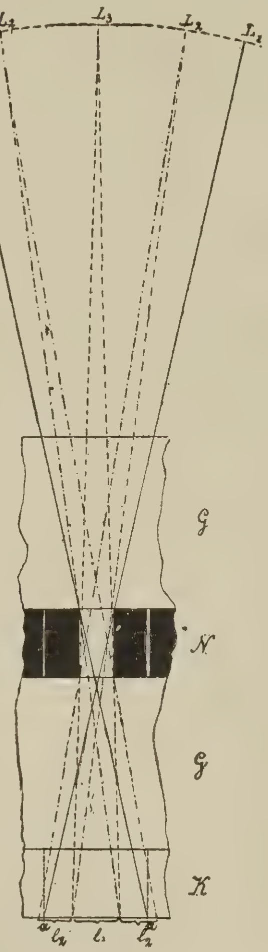

Fig. 9.

	Value of Angle β.	Value of Angle e.	Sideway distance of light sources from each other at a distance from the printing surface equal to:—		
			20 cm.	50 cm.	100 cm.
1. Warner-Powrie. Width of line a = ·04 mm. Thickness of line b = ·01 mm. .... Thickness of glass c = 1·4 mm.	88°	smaller than 2°	less than 6 mm.	less than 15 mm.	less than 30 mm.
2. Krayn screen. Width of line a = ·04 mm. Thickness of line b = ·13 mm............ Thickness of glass c = ·1·0 mm.	82°	smaller than 8°	less than 27 mm.	less than 68 mm.	less than 135 mm.
3. Krayn screen. Width of line a = ·14 mm. Thickness of line b = ·13 mm. .... Thickness of glass c = 2·0 mm.	85°	smaller than 5°	less than 18 mm.	less than 44 mm.	less than 88 mm.
4. Krayn screen. Width of line a = ·14 mm. Thickness of line b = ·13 mm. .... Thickness of glass c = ·00 mm.............	43°	smaller than 47°	less than 168 mm.	less than 420 mm.	less than 840 mm.

In the fourth section of the table an example is given of the value of the angles—that is to say, the angular separation of the central and two sideway sources of light, in order to produce the best printing for a given system of lines, and without the use of an intermediate film. The figures thus obtained as a guide to practice, although only approximate, are still sufficiently correct, and show most plainly that for the different line-filter systems used at not too great a distance from the source of light when printing (the screens being crossed) one single source of light is sufficient, providing that the filter-plate is mounted on a separate support or that one is interposed, and that the source of light is not a point only. However, in practice the actual sources of artificial light, such as a mantle or electrical filament, possess sufficient area that they can be brought comparatively close to the printing film, and for a line system can replace the theoretically necessary sources of light, but this is not the case when printing is done without any intermediate film. Here it is necessary, as already shown by the example, that the rays, or rather each two taking part in the printing process, shall include an angle of 45 degrees. The exact value of the angle depends, as can easily be seen, on the relation of the breadth of the line to the thickness thereof. In the case of the Krayn film the thickness is equal to the breadth, and therefore the angle must be half a right angle.

It may now be asked how the above rules may be generally applied to a screen-plate consisting of a number of lines of equal width, and what conclusions may be drawn as to the simplicity and practicability of the printing method or arrangement of the sources of light in any given case. It is easy to see from the foregoing statement that it is necessary to regard the printing of the line screen-plate used against a crossed screen from two sides: (1) According to whether the two screen-plate films are separated by an intermediary film, and (2) whether they are in contact. The first case is that of the Warner-Powrie and similar products. In the case of the Krayn films, if an intermediary film is used this latter, according to the values given in the tables, requires more or less perpendicular (2 to 8 degrees) rays for each separate system of lines.

Such rays emanating from one source of light must fall on the whole printing surface providing that the light source is of sufficient area. The necessary size of the luminous surface can be calculated from the table. Thus, in example No. 3, the source of light must have an area 2 by 44 = 88 mm. if it is placed 50 cm. distant.

Welsbach mantles, electrical lamps, etc., when placed with their length parallel to the filter lines of the printing plate, are available for this purpose. Ways and means must now be found to distribute the rays equally over the whole printing surface. Sideway reflection by means of mirrors or angling of the printing frame in relation to the line joining it to the source of light, is to be employed in the above cases only when care is taken that the sideway rays form only a small angle with the perpendicular or direct rays. The same result is obtained by simple to-and-fro movement of the printing frame; but the use of three sources of light, each of small luminous area, and suitably placed in regard to the printing frame, appears less advisable on account of the comparatively close juxtaposition in which they must be placed.

In the case of filter films employed without the interposition of an intermediate film, the sideway printing rays, according to the table, must form a considerable angle with the rays falling perpendicularly. The angling of the printing frame possesses its full value in this case, and appears to be more simple in its effect than the use of mirrors placed at the side. This mirror is necessarily fixed to the printing frame, and on the latter b angled the mirror must include an angle corresponding to that in the table between the line of its previous position and the normal position. The crossed screens must be so laid in the printing frame that the lines of the printing surface run continuously with the sides of the printing frame provided with mirrors. The filter lines must run in the same direction on the frame being angled.

It must now be mentioned that other phenomena than the above have to be considered in regard to their influence on the printing of the copy. If, however they were to be discussed at length the scope of the present article would have to be immensely enlarged, without, it may be said, leading to any matters of real interest in a practical way. It is, at any rate, a fact that all these phenomena, such as refraction in the various media, reflection from the several surfaces, scattering of light in the films, etc., exert a secondary influence, and for this reason should not be entirely overlooked.

Two points require to be mentioned. The reproduction of the colour effect must give rise to a certain degree of unsharpness, particularly in those outlines of the picture which run obliquely to the position of the filter lines. These outlines will run in a broken stepped manner instead of being as straight lines, and will resemble somewhat a certain kind of cross-stitch employed in ornamental needlework. The finer the filter lines the less visible will this breaking of the outline appear. It will also be observed that the perpendicular crossing of the printing and negative screen is the most advisable, and that both the reproduction of the colour and the sharpness of the picture suffer by an oblique superposition of the two sets of lines. The extreme in this direction is reached when the two lines are allowed to run almost parallel, under which condition the most disturbing moirée effect is produced. From the above experiments and calculations some conclusion may be formed as to the type of screen-plate which may be regarded as the most practicable. Such should conform to the following requirements:—

1. The breadth of the filter lines should be appreciably greater than their thickness (thickness of the whole filter film).
2. The breadth of the lines should be, so far as possible, sufficiently small to render the series of lines completely invisible to the eye.
   (a) The filter film should be of the greatest possible continuity consistent with its manufacture.
   (b) On this account it is inadvisable to make the filter film at the same time the support of the sensitive emulsion.
3. Filter film and sensitive emulsion should be in the most intimate contact.
4. The filter film should be of the greatest possible transparency.

Some further results of the above inquiry may be summarised as follows:—

1. A notable distinction must be drawn between the case in which the negative and printing surface are separated by colourless intermediary film and the condition in which they are not. The printing method must be modified according to one or other of these conditions.
2. If there is an intermediary film the colour reproduction is better, as a closed (continuous) image can be formed.
3. The plan of inserting a colourless intermediary film is, therefore, advisable when the material itself does not provide one.
4. The intermediary film must be chosen of suitable thinness, otherwise unsharpness of the copy may result. Its precise thickness depends on the ratio of the width of the lines to the thickness of the filter film, and of the distance of the source of light employed for printing.
5. It is generally advisable to employ an angle of 90 degrees for the crossing of the negative and positive filter lines.
6. The screen lines of the printing film must be so placed in the frame that they run continuously with those sides of the frame which carry the mirror, or which are moved in relation to the source of light when angling the frame. The source of light itself, if it has any lengthy surface, must be placed parallel with the lines of the printing plate.

Dr. E. Stenger.
F. Leiber.

THE DEVELOPMENT OF AUTOCHROMES.

The method of developing Autochromes now advised by Messrs. Lumière provides means of overcoming the effects of incorrect exposure, and doubtless this fact has induced many to try it. The details were published in "Colour Photography" Supplement for June 5, and they are now issued in leaflet form with the plates. We have recently experimented with the method, and with very satisfactory results, for our exposures were made in a bad light and under conditions that rendered it very difficult to estimate the correct exposure at all. It is not easy to match exactly an actinometer tint in a poor light, for the colour assumed by the paper seems to vary somewhat with the quality of the light. Further than this, when the light is continually varying, the use of a multiple of the actinometer time is liable to give large errors. So far as we could judge in our test the exposure should have been 32 minutes, but a sudden falling off in the light induced us to extend it to 45 minutes. The correctness of the exposure was thus a matter of considerable uncertainty. In developing, the image appeared in 35 seconds, and the addition of 15 cc. of ammonia solution was then made in accordance with the instructions. The final result was very fairly good, its faults being due to bad light rather than to wrong exposure. As a matter of fact, the time required for development seems to show that the exposure was not very far from being correct; but, without having the clue afforded by the time of appearance, we should certainly have been tempted to prolong development, under the impression that we were dealing with a case of under-exposure.

The advantage of the new method is that it substitutes certainty for uncertainty. Previously we have hopelessly spoilt many plates by exposing under precisely the same conditions of light. When it is practically impossible to determine the correct exposure with certainty, failures are sure to be numerous if we have no means of controlling the result in development. No plate requires control so much as an Autochrome, and no developer affords a means of control so well as pyro-ammonia. Therefore, it appears to us that the improved method of developing is of very considerable importance.

A little difficulty may be met with in making the required alteration in the developer. If one bungles, it is easy to spend half a minute over the addition of, say, 15 cc. of ammonia solution to the developer, and when only 2 cc. are necessary it is easy to add too much. We should advise putting the solution into a dropping bottle, dropping for the small quantities, and pouring for the larger ones. A 2 oz. bottle holds as much as is likely to be required for a half-plate. The "Virida" paper safelights provided by the Lumière give quite enough light to enable one to see the graduations on the measure, and there is no particular difficulty to contend with other than that of time. But it is important to be as quick as possible, otherwise the scheme of development is more or less upset.

The "Virida" papers are advised to be used in sets of two green and three yellow papers for a 16 c.p. incandescent lamp. We use a "Gem" incandescent mantle in our lantern, and these five papers gave such a brilliant light that it appeared to be unnecessarily strong. Eventually we added an extra sheet of green, and one sheet of white type-writing paper, and so obtained a soft green light that is very pleasant to work by, and that is apparently quite safe enough for the purpose. The transparent sheet of developing times is bound up with the rest, and the details are quite easily read. The plate is put into the dish and covered with developer in the dark. At the end of 20 seconds the light is turned up, and when the image has appeared and the developer has been modified, the dish is kept covered for the rest of the time.

The following is a translation of the Lumière formulæ into practically equivalent English weights.

AA.	Bisulphite of soda solution	15 mins.
	Pyrogallic acid	130 grs.
	Potassium bromide	130 grs.
	Water to	10 ozs.
BB.	Soda sulphite (cryst.)	2 ozs.
	Ammonia .880	1 oz.
	Water to	10 ozs.

Dilute solution BB to ¼ strength for use—that is, take—

Solution BB	2½ ozs.
Water to	10 ozs.

To develop a ¼-plate take—

Water	1 oz.
Solution AA	1 dram.
Solution BB (diluted)	1 dram.

The development table for a temperature of 60 deg. F. will then be as follows:—

Time of appearance.	Add BB diluted.	Total time of Development.	
Seconds.		Mins.	Secs.
22 to 24	none	2	—
25 to 27	12 mins.	2	15
28 to 30	48 mins.	2	30
31 to 35	1½ drams	2	30
36 to 41	2 ,,	2	30
42 to 48	2½ ,,	2	30
49 to 55	3 ,,	2	45
56 to 64	3½ ,,	3	—
65 to 75	4 ,,	4	—
Over 75	4½ ,,	5	—

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TRANSFORMATION PHOTOGRAPHS ON AUTOCHROME PLATES.

Herr Jan Szczepanik, in a recent issue of "Photographische Industrie," remarks upon the practicability of using the Autochrome plate for the making of a single transparency, in which, according to the use of a particular filter, three different pictures can be seen. The process obviously depends on the use of a red, green, and blue filter, in each case corresponding to the colour of the starch grains, and used at the time of making the exposure. Thus the use of a red filter—the neutral red of Cassella can be used—corresponds with the red starch grain filter of the Autochrome plate, and therefore when it is used on the lens in making an exposure an image is produced only on the parts of the film behind the red starch grains. A second exposure may be similarly made on the same plate, using a filter of naphthol green, and finally the third exposure, again on the same plate, can be made with a filter of Victoria blue or cresyl blue.

After development and reversal the three pictures present the appearance of having been printed in the respective colours upon one another on the same plate, so that no distinct image is recognisable, but when each is examined through its correct filter the picture becomes clearly visible against a black background. Such transformation pictures are quite easily made on the Autochrome plates, which can also be used for the production of a stereoscopic pair of pictures, each the full size of the single plate. This is very simply done by taking the right-hand picture through a violet filter, such as the crystal-violet of Hoechst. This gives an image in the parts of the film behind the red and blue starch grains. The picture for the left eye is then taken through a yellow screen-filter, and after development and reversal the composite picture is observed through a pair of spectacles, of which the glass for the right eye is of the colour for the right-hand picture—namely, violet, and the other yellow-green. The stereoscopic effect of the print is thus obtained in accordance with the well-known stereoscopic principles

Correspondence.

⁂ *Correspondents should never write on both sides of the paper. No notice is taken of communications unless the names and addresses of the writers are given.*

⁂ *We do not undertake responsibility for the opinions expressed by our correspondents.*

YELLOW LIGHT FOR THE DEVELOPMENT OF AUTOCHROMES.

To the Editors.

Gentlemen,—Much has been written and much consideration has been given to the development of these plates in the past, and in the early days of Autochrome manipulations time development was employed at fixed temperatures. Further, elaborate instructions have been given from time to time as to variation of time of development for alteration in temperature of the solutions. The next stage to this seems to have been the recommendation by some of acid amidol as developer.

Later than this, Messrs. Lumière have issued a modified formula of their original developer, and recommend this and careful inspection of the plate during development by the light of a lamp fitted with their Virida papers. All these modifications I have employed, and further found some weeks back that the Virida safelight (two green and three yellow sheets) was quite safe, even when the original formula of pyro-ammonia developer was used.

It struck me, as it may have done in the case of many others, that considering the slowness of the emulsion of the Autochrome plate, the only thing to fear was fogging, when development was watched, owing to the plate's sensitiveness to colour.

I have further thought that if this colour sensitiveness was by any means destroyed we should have the equivalent of a plate slower than, or of the speed of, the ordinary lantern plate. I then argued that, if this was true, the Autochrome plate, robbed of its colour sensitiveness, could easily be developed in the same safelight as a lantern plate. My method of procedure was as follows:—I lit my dark-room lamp (fitted with Bray's No. 1 gas burner) and inserted my safelight, which is two thicknesses of Canary medium, and turned down the light to the blue. Then I removed my exposed Autochrome from the plate-holder and slipped it rapidly into a developing dish containing a 3 per cent. solution of metabisulphite of potash. Here it remained 30 seconds. I then turned up my light to the full and proceeded to wash the plate in running water for one minute in the full light of the lamp.

This being done, I flooded the plate with the old formula, pyro-ammonia developer, and developed my Autochrome without the least suggestion of fog occurring during a period of 2½ minutes. This was done in the full light of the lamp and as near as my dish margin would allow me to approach the light.

The final Autochrome was eminently satisfactory as regards colour-rendering, brilliance, and translucency. Having developed this Autochrome, I then tackled one of similar subject and exposure, and developed it by the modified developer recommended by Lumière and in the Virida safelight, and I must confess I was not so pleased with the result, although the processes throughout, after development, were under identical conditions with the first.

My experience with the yellow safelight further emboldened me to risk the manipulation of a 1/1 plate, and I was rewarded by a most signally successful Autochrome.

This method of manipulation may be employed by many, though I have never seen or heard of its mention in any paper, and therefore in case it may be of assistance to some I write this account of my experiences. To my mind, the advantages of this method are:—

(1) The yellow light is much more comfortable to work in than the green safelight.

(2) The development can be stopped at precisely the right moment.

(3) Errors of exposure can be more easily dealt with.

(4) Risk of failure from error in development and exposure can be almost abolished.—I am, yours faithfully,

H. G. **Drake-Brockman**, M.R.C.S.

Cleveland Asylum, Middlesbrough.

No. 23. Vol. II. NOVEMBER 6, 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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SENSITISERS AND DESENSITISERS FOR BLEACH-OUT DYES.

IN my article on the "Uto" bleach-out process in the September Colour Supplement I mentioned having examined a large number of new sensitisers, and referred to some being so sensitive that the addition of one part to 50,000 parts of "Uto" emulsion was sufficient to turn the scale of colour obtained in bleaching right over to the complementary. These bodies are, however, better designated by the name of *desensitisers*, as they generally do not in themselves sensitise for any particular dye, but reduce the speed of the bleaching for one or more dyes, and that frequently to an enormous extent.

The volatile oils may generally be classed into one or other of these two divisions, sensitisers or desensitisers. Some, of course, are weaker in their action, but it is exceedingly rare to find an oil which is absolutely neutral.

The results vary considerably according to the conditions that obtain—e.g., the nature of the dyes themselves, the presence or absence of other sensitisers, the nature of the carrier of the dyes, etc., are all conditions which affect the results obtained—and this fact will probably lead to many apparently contradictory statements with regard to the action of different sensitisers by various experimenters.

A weak sensitiser in the presence of a strong one may be entirely overpowered, and apparently possess no sensitising action. A very strong sensitiser may, on the other hand, appear under unfavourable conditions to have no action—e.g., in the presence of a trace of a desensitising body.

The bulk of my experiments have been conducted with basic dyes embedded in nitro-cellulose. Just as the presence of a certain amount of moisture is necessary in order to render acid dyes embedded in gelatine amenable to the action of sensitisers, so is the presence of some diffusing body, such as glycerine or castor oil, necessary in combination with basic dyes embedded in nitro-cellulose, in order that they may be amenable to the action of their corresponding sensitisers applied externally. A drop of the strongest sensitiser applied to a hard film of collodion containing basic dyes has not the slightest action. The only exception I have found to this rule is the case in which the sensitiser is at the same time a solvent of the collodion film, as sometimes happens.

As the blue and yellow colours I usually employ belong to one group of dyes, while the red colour belongs to another group, it frequently occurred that the sensitisers employed showed a decided leaning to sensitise either for green or for red. Although this case was very general, it sometimes happened that the sensitiser in question sensitised for orange or for violet, never, however, quantitatively so to speak, but only in a general sense. This rendered it very difficult to arrive at a happy combination of sensitisers which would sensitise for all three colours evenly, more especially as the action of a combination of sensitisers was in many cases quite different to what the sum of the actions of the individual members would lead one to conclude, this being probably due to interaction between the sensitisers themselves.

I have examined all the practically available volatile oils, both alone and in various combinations, the most interesting results being as follows:—As a single sensitiser, I must repeat my former statement that anethol, which was first recommended by Worel, holds a place of pre-eminence. It sensitises all the three colours I employ, unfortunately not quite evenly, as yellow partially remains, but it is one of the very few bodies which sensitises for all the three dyes.

Other important sensitisers are the oils of:

Cassia
Cedar leaves
Cedro
Cinnamon
Citronella
Mustard
Peppermint
Pine
Sage
Spike
Spruce

The following oils were strong desensitisers:—

Caraway oil
Clove oil
Oil of origanum

By desensitisers is to be understood generally not only that the bodies in question reduce the speed of bleaching when no special sensitiser is present, but that they are capable of counteracting entirely the action of the addition of the strongest sensitisers. The action was strongest in the case of oil of cloves and upon the blue and yellow dyes. It can hardly be explained by a chemical action upon the sensitisers, as less than one per cent. of the quantity of sensitisers was sometimes sufficient to counteract their action completely. The importance of these desensitisers in fixing the dyes after the colour print has been obtained and the superfluous sensitisers washed out, as referred to in my former paper, must be apparent. In addition they may be usefully employed in minimum quantities in the emulsion to regulate the bleaching out of the dyes.

Being anxious to find to what chemical bodies the sensitising and desensitising actions of the oils were due, I examined all the ordinary pure chemical products derived from the volatile oils, and append a list of these divided into their two classes :—

SENSITISERS.

Amyl salicylate
Apiol
Benzoic aldehyde
Benzyl acetate
Benzyl aldehyde
Benzyl valerianate
Borneol
Bornyl acetate
Camphene
Carvene
Cinnamic acid
Cinnamic aldehyde
Citral
Citronellal
Citronellol
Coumarin
Cumol
Cymene
Eucalyptol
Geraniol
Geranyl acetate
Helenin
Heliotropin
Isoborneol
Isosafrol
Linalol
Linalyl acetate (Bergamoil)
Menthene
Menthol
Menthon
Menthyl acetate
Menthylheptennon
Menthyl valerianate
Methyl salicylate (Wintergreen)
Muguet
Musc
Myrtol
Nerolin
Phenetol
Pinen
Safrol
Santalol
Terpeneol
Thujone

DESENSITISERS.

Anisic aldehyde
Carbolic acid
Carvacrol
Carvone (Carvol)
Eugenol
Isoeugenol
Salicylic aldehyde
Tannothymal
Thymol
Vanillin

The bleaching properties of the oils may be very fairly gauged by the action of their ingredients. Thus, the oils of cassia and cinnamon bleach similarly to cinnamic aldehyde, their chief constituent, the oils of pine, spruce and sage similarly to pinene, the oil of sweet marjoram like the terpines, cedro like citral. The bleaching action is not always due to the chief ingredient of the oil—e.g., the action of citronella oil is due chiefly to the citronellal, of which only 12 to 20 per cent. is present—and in the case of peppermint oils the action is due more to the menthone (5 to 15 per cent.) than to the menthol, of which 40 to 50 per cent. is present.

It also very frequently happens that even small impurities of bodies exerting a desensitising action are present, and these may destroy the natural bleaching action altogether. This occurs often with eugenol as impurity. This desensitiser is present to the extent of 70 to 85 per cent. in oil of cloves, and explains the desensitising action of this latter. Similarly the action of oil of origanum is due to the presence of 60 to 85 per cent. of carvacrol, while oil of caraway contains 50 to 60 per cent. of the desensitiser carvone. Eugenol and isoeugenol are the most energetic desensitisers, then follow carvacrol and thymol.

As a chemical class the aldehydes are prominent in yielding vigorous sensitisers, and, as might be expected, it is the most highly oxidised bodies, generally speaking, which exert the greatest bleaching action. As an example, the aldehyde citronellel $C_{10}H_{18}O$, which may be obtained artificially by the oxidation of the primary alcohol citronellol $C_{10}H_{20}O$, bleaches much more energetically than the latter, while the aldehyde citral $C_{10}H_{16}O$, obtained artificially by the oxidation of the primary alcohol geraniol, of the same composition as citronellal $C_{10}H_{18}O$, is the most energetic of all the four in its bleaching action.

Judging from the small quantity of desensitiser necessary to prevent the bleaching action, as compared with the large quantity of chemicals required, even in the case of energetic sensitisers, to obtain a fairly rapid bleaching-out of the dyes, it would seem that the desensitiser either enters into a chemical combination with the dyes, or that the desensitiser is itself more readily oxidised by the liberated oxygen than the dyes in question. If a chemical combination takes place it cannot be a very intimate one, because generally on exposing the sensitive layer in the dark to the air in course of time the desensitising action ceases, no doubt due to the volatilisation of the desensitiser. The bleaching of the dyes is, on the other hand, effected by the absorption by the dyes of the slowly liberated oxygen from the sensitising bodies under the action of the light.

The volatility of the sensitisers is a matter of serious importance, and I propose to prevent this not only by packing the finished paper in tinfoil, but by covering the surface of the paper with a transparent film capable of imprisoning the sensitisers until the prints have been taken. A thin coating of colourless gelatine will not only serve this purpose, but also prevent the glass positives from being spoiled from direct contact with the dyes and sensitisers. The gelatine film can be easily stripped off after printing in order to fix and finish off the prints.

DR. J. H. SMITH.

THE COLOUR PROPERTIES OF THE AUTOCHROME PLATE AND THE PROCESSES OF REPRODUCING AUTOCHROMES.

[Baron von Hübl, in a further article in the "Wiener Mittheilungen" on the Autochrome plate, deals with the properties of the latter particularly from the point of view of reproducing one Autochrome from another, an aspect of screen-plate colour photography to which attention was first drawn by Dr. C. E. K. Mees, in the "Colour Photography" Supplement, and which has been further discussed by Dr. E. Stenger and F. Leiber.—EDS. "Colour Photography" Supplement.]

THE transparency of the Autochrome plate towards white light is obviously dependent upon its peculiar texture. If the starch grains were completely transparent they would allow the red, green, and blue thirds of the spectrum to pass through unimpeded, and therefore the white light transmitted would be one-third of that falling upon the plate. But as the starch grains are not completely transparent, and, further, have their interstices occupied by black filling, the intensity of the light transmitted is about one-tenth. The starch grain of the plate thus reduces the intensity of the light to one-tenth part without in other respects altering it—that is to say, it behaves exactly similarly to a homogeneous grey film or one composed of black lines or points, and the light transmitted, so far as its photographic properties are concerned, in no way differs from ordinary white light.

The above is the theoretical conception of the plate, and does not tally precisely with its behaviour in practice. Since the dyes which make the plate have not perfectly sharp edges to their absorption bands, the spectrum of the light passing through the starch grains of the plate shows, after re-combination of the red, green, and blue tones, two weak absorption bands. Thus in the light which has passed through the plate there is a slight lack of yellow and blue-green, which slight difference from the normal composition of white light is noticeable only in very exceptional cases, and therefore the assumption above made that the light is weakened, but not otherwise altered, may be taken as correct.

In accordance with the now well-known method of action of the Autochrome plate, the presence of an opaque deposit upon some or other of the grains causes the development of certain colours—that is to say, if the blue and green grains are covered only the red remains transparent, and the plate thus transmits only red light. This red light possesses the same composition and other properties as any light which has passed through a similarly uniform red glass filter, and in both cases corresponds to the red light of one-third of the spectrum: the process of forming the colours is alike in both cases.

If a colourless glass plate be uniformly coated with a transparent red film, this latter will absorb the green and blue portions of the spectrum, and if two-thirds of its area be covered a similar result is obtained as when, by covering up the green and blue starch grains of the Autochrome plate with a black silver deposit, we cut out two-thirds of the area and allow only the red grains to remain uncovered. It may thus be said that the red on the Autochrome plate consists of two parts black and one part red,[1] and that this black is as necessary for the constitution of the red colour as is the absorption band of a red pigment—that is to say, it is a cut-out of two thirds of the spectrum. In fact, the red-coloured glass appears to us much brighter and purer than the red produced in the Autochrome plate only because the latter is formed in a plate which allows only one-tenth of the light to pass through. If a colourless but neutral grey plate (of transparency only one-tenth) is bound up with a completely transparent red film, the composite plate appears as blackish as the red of the Autochrome plate. The grey plate transmits one-tenth, and the red film one-third—that is to say, the two together transmit 1-30th of the white light, and, as in the case of the Autochrome plate, the red grains transmit one-tenth of the light, whilst only one-third of the total area is occupied by them; the light transmitted by the surface is also 1-30th of the original white light.

Quite similar in action to a homogeneous grain plate is a ruled screen the black lines upon which are ten times the width of the interspaces. Such a plate bound up with our transparent red film will again transmit 1-30th of the incident white light. Also, a three-colour screen-plate—that is, an Autochrome plate—deprived of its gelatine film must behave similarly, since, when covered with the red film, it corresponds with a cut-out of the green and blue grains. Similar statements apply for all the different colours, and the appearance of an Autochrome thus corresponds with an image formed of pure homogeneous colours, such as the transparent films of a three-colour transparency in contact with a transparent or fine-lined screen of transparency one-tenth, or with a three-colour screen-plate.

The difference between a three-colour transparency and an Autochrome is thus dependent only upon the variously transparent support, and if one is illuminated ten times more brilliantly than the other both have the same appearance.

This description can easily be confirmed when a series of variously coloured gelatine films, illuminated by transmitted light, is photographed upon an Autochrome plate and then compared with the original, both again being illuminated by transmitted light. The original possesses great brilliancy, but if covered with a grey glass plate, with a line screen-plate, or with a Lumière grain-plate, it has quite the appearance of the Autochrome copy. This fact should be kept in mind in considering the methods of reproducing Autochrome transparencies by any printing process. There is no doubt that a transparent colour original, such as a three-colour transparency, can be photographed on an Autochrome plate, nor that such an original can be printed upon bleach-out paper, nor again that faultless sets of negatives for three-colour work can be prepared from such originals. No difficulty is introduced into these operations by covering the original with a greyish plate transmitting only one-tenth of the light—that is to say, by imitating the conditions of an Autochrome—the obvious course being to give ten times longer exposure on account of the diminished transparency, or to employ a light of ten times the strength. Yet, if we wish to reproduce an Autochrome in this way, we meet with difficulties which must be more closely inquired into. In this connection two characteristic properties of colours come into play—namely, their non-homogeneity and their saturation.

The Non-homogeneity of Colours.

The colours composing the Autochrome plate are not homogeneous, but are produced by small opaque black areas which form a kind of screen structure upon the plate. In order to ascertain the influence of these black elements upon the reproduction it is necessary to imagine first the film side of an ordinary positive transparency as covered with a screen consisting of dots or lines and in course of being photographed by transmitted light. On short exposure there is obtained throughout the whole scale of tones a uniformly screened negative, which, however, shows a correct ratio of light and shade. A print therefore appears much too dark in all parts in comparison with the unscreened original. If a slight diffusion of focus is obtained, so that the black elements are no longer separately represented, it is possible by suitable choice of exposure to obtain a negative which corresponds exactly with the unscreened original, but shows diffused outlines. If the grain elements are very small they cease to be sharply rendered, they are scarcely more than visible in the high-lights of the negative, whilst in the shadows they disappear completely, and there is obtained a negative which, though theoretically is not exactly the facsimile of the non-screen original, yet in its gradation is practically a perfect reproduction. In this case the screen structure of the original has been eliminated in the photographic copy.

These conditions are realised in the structure of the Autochrome plate, the grain-screen acting as a diffusing medium of the light tones without, however, affecting the correctness of the gradation. The Autochrome plate thus, on being copied by reduction in the camera or by contact, behaves as a homogeneous image, and its structure certainly does not play the part which has been ascribed to it, in producing diffusion of focus for the purpose of rendering the tones homogeneous, but on the contrary is injurious, since it gives rise to coarseness of structure which creates a more disturbing effect than the uniform starch grain.

Saturation of the Colours.

The next point is the relatively small saturation of the colours in the Autochrome plate. A copy upon an Autochrome plate of the chart of coloured films above referred to shows, on comparison with the original, that in spite of the apparent brilliance all the colours are too whitish, that is to say, of insufficient saturation. In order to take some basis for comparison in this connection the saturation of the original chart of films and its reproduction on the Autochrome was obtained in figures, the transparency for red, green, and blue light (corresponding to the respective wave-lengths of 600, 520, and 460) being measured. From these data the densities, that is to say, the thickness of the absorption band for these portions of the spectrum, were ascertained, and it was assumed that these latter represent the average value throughout the complete spectral zone. The measurements were made in a double-slit spectrometer of Schmidt and Haensch.

In examining the Autochrome plate, an Autochrome starch-grain film was placed before the second slit, and so the transparency of the colours apart from that of the starch-grain film was obtained. The negative logarithms of the transparency correspond with the densities in the three spectral zones, and in the case of the Autochrome colours represent at the same time the densities of the silver deposit, that is to say, are proportional to the silver covering the starch grains. As very small transparencies had to be measured, an operation which is particularly liable to error in the blue zones of small intensity, the results can only be taken as approximate as regards the saturation, but are nevertheless sufficient for the discussion of the problem now before us.

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[1] F. Leiber in "Zeitschrift für Reproduktionstechnik, 1908" ("Colour Photography" Supplement, October 2, 1908, page 76), regards the total blackening of the grains as a degradation of the colours and assumes from this the unfitness of the Autochrome plate for three-colour purposes. A study, however, of the properties of the plates will show the incorrectness of this view, which the author admits he had himself entertained at one time in order to explain the difficulties in the reproduction of Autochromes from Autochromes.

In fig. 1, A represents the result obtained for a film of saturated blue colour. The red, green, and blue spectral zones are represented as *r*, *gr*, and *bl*, and above these are the densities obtained for the middle portions of the zones. The scale of densities is placed to the left, and it will be seen that the density in the red zone is 1.8, in the green 1.1, and in the blue 3.[2]

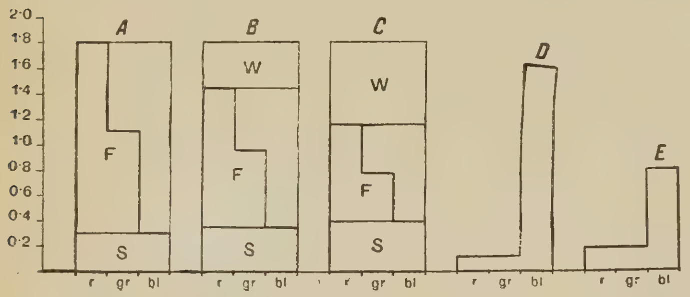


Fig 1.

If these films are photographed by transmitted light on an Autochrome plate the result shown as B is obtained, from which it is seen that the densities are much smaller.

A colour diagram of this kind consists of three parts. The portion marked S indicates the density which extends uniformly over the whole spectrum, and represents the blackness of the colour as it uniformly "dampens" the brightness of all rays. The second, marked F, is the part characterising the densities of the red and green which are necessary for the formation of the colours, whilst the third portion, W, corresponds to the whiteness of the colours. The density in the red zone does not reach the value of 1.8 as in A, and therefore the light coming through the colour surface contains red, green, and blue rays making a white mixture.

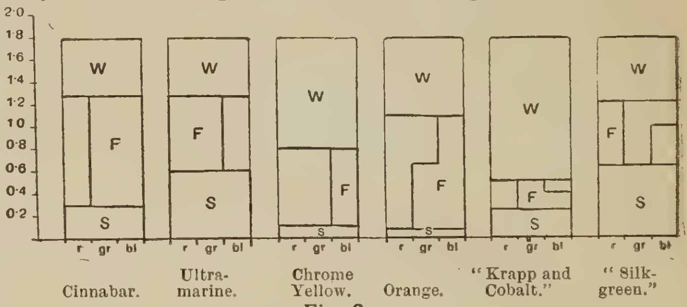
In representing the Autochrome colours, according to this method, the three spectral zones correspond to the three sets of starch grains, and the densities represent the amount of silver covering the grains, and therefore we arrive at a ratio for the diagam B of the amount of silver lying upon the red, green, and blue grains of 10 : 6.4 : 2.4. If now the Autochrome exposure is made from a light blue film, of the kind represented in B, we obtain a blue which corresponds to the diagram C possessing still less saturation. From the area of the surface of the three portions, S, F, and W, the compositon of the blue colours can be ascertained and is given in the following table:—

	Black.	Colour.	White.
A	16	84	—
B	18	59	23
C	20	46	34

As will be seen from the above, the proportion of black in the reproductions does not rise to a considerable extent; colour is however lost, and, at the same time, a certain amount of white formed which lowers the saturation.

Experience teaches that the depression of the saturation is not the same with all colours, and it is especially noticeable in the case of the yellow. A saturated yellow film shows the density ratio given in D, fig. 1, and the deposit on the grain in the Autochrome reproduction is seen from E, fig. 1. The blue grains are thus so incompletely covered that they give rise to a very whitish yellow, and when such a white-yellow is photographed scarcely more than a trace of it is obtained in the reproduction.

In order to study the behaviour of pigment applied to paper in this respect the colour chart of the author, consisting of nine tones, was photographed, and the resulting colours similarly examined. Fig. 2 shows that the reproduction even of the most saturated colours, such as cinnabar and ultramarine, gives a deposit on the grains of only 1.3, and that these colours, as well as all the others, contain a good deal of white. It is also seen that ultramarine on paper is a very impure blackish colour, and that "silk-green" (a mixture of Paris blue and yellow) also contains a good deal of black. Chrome yellow and orange are very pure colours which are reproduced much too white, and "krapp and cobalt" exhibits the character of a very impure colour, which, in the original, is very white. The following table gives the composition of the six colours at a glance:—



Cinnabar. Ultra-marine. Chrome Yellow. Orange. "Krapp and Cobalt." "Silk-green."

Fig. 2.

	Colour.	Black.	White.
		Per cents.	
Cinnabar	55	17	28
Ultramarine	39	33	28
Chrome yellow	40	5	55
Orange	56	4	40
"Krapp and Cobalt"	15	13	72
Silk-green	33	33	34

From these experiments it may be taken that all Autochrome colours contain various but nevertheless considerable proportions of white, and if they give the effect of a saturated colouring it is chiefly to be ascribed to the fact that they are formed on a blackish substratum and are therefore seen by comparatively weak illumination. Even coloured papers appear more strongly coloured in a weak light than in direct sunlight.

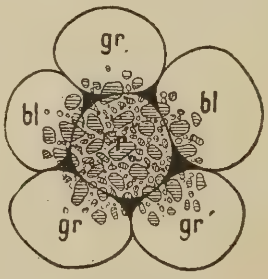


Fig. 3.

The saturation of colours which are too white can be raised by ample intensification, but then the colours which are already of sufficient saturation are represented as too dark, and the whole image tends to become blackish.

The loss of colour in an Autochrome reproduction recalls the defect of ordinary black-and-white photography, as regards the reproduction of light and shade. As here, the soft gradation is lost in the high-lights, as these latter are over-exposed when ample time is given to the shadows—that is to say, in the case of the Autochrome the whitish soft colour tones are apt to go because the saturated and blackish portions of the original require too long an exposure. Intensification will not remedy this inherent defect of the process.

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[2] The density of D = 1 corresponds to a film of transparency T = $\frac{1}{10}$, that is to say, to a film which transmits 1-10th of the incident light. The above densities, therefore, mean that the films are covered with a density which in the red zone is 1·8, in the green 1·1, and in the blue ·3. As D = log. T these three densities correspond to transparencies of ·01, ·1, and ·6, and the light which thus reaches us through the blue film consists of one part red, 10 parts green, and 60 parts blue.

The above thus gives an explanation of the loss in colour in the case of the bright light tones, but the fact that all the colours show the loss in saturation and that the yellow is represented so whitish are characteristics which no doubt are due to irradiation phenomena. If a dull-red light reaches the plate it passes through only the red grains, and it should, therefore, only affect the particles of silver bromide which lie behind them and form a silver deposit on development. However, a microscopic examination of the fixed plate shows that this is not the case, but that the silver bromide has been also darkened in the immediate neighbourhood of the red grains. The density of the red elements is thus not absolutely sharply defined, but spreads somewhat, as shown in fig. 3, over into the margins of the neighbouring green and blue grains. This irradiation is possibly to be traced to refraction phenomena, as the diameter of a grain amounts to about .01 mm, and is about as great as its distance from the silver film.

When the developed negative is converted into a positive with the permanganate, the blue and green grains should be completely covered, yet their edges remain somewhat transparent, and thus the light passing through the plate consists not only of red rays but contains also green and blue, and this gives to the dark red a whitish tinge.

In the case of those colours which involve the blackening of one kind of grain, such as red, green, and blue, this phenomenon can be of much slighter effect than in the case of colours which involve the darkening of the silver bromide lying behind two different sets of grains, for the reason that in this case the undarkened grains are surrounded by double the number of darkened grains. On this account yellow, blue-green, and purple are more liable to admixture with white than red, green and blue.

This phenomenon necessarily takes place more noticeably the stronger the light falling upon the starch grains, and is, therefore, but very little noticeable in the case of darkish colours. This is no doubt the reason why the whitening of the yellow is chiefly noticeable, since pure yellow is frequently met with, whilst blue-green and purple are usually met with in Nature only as broken colours—that is to say, containing much black.

A. von Hübl.

SOME POINTS IN STEREOSCOPIC PHOTOGRAPHY WITH THE AUTOCHROME PLATE.

[The following paper, translated from "Photographische Rundschau," gives the rules and principles to be borne in mind when preparing Autochrome stereoscopic transparencies. The conditions of Autochrome stereoscopic photography theoretically affect both the taking and viewing of the plate, though it may be questioned whether the error of parallax to which Dr. Luther alludes comes into play to an appreciable extent.—Eds. "B.J."]

As soon as the Lumière plates were placed upon the market much use was made of them for stereoscopic pictures, although but little has been seen of this form of Autochrome, an indication that there are certain difficulties which require to be overcome. And it is a fact that the making of stereoscopic transparencies on the Autochrome plate involves certain points which must not be overlooked. When attention is given to them the results are extraordinarily beautiful. The following notes, therefore, are offered for the consideration of those who, whilst already familiar with stereoscopic photography, have perhaps not recognised the precautions involved by the use of the Autochrome plate.

Correctness as Regards Right and Left.

Anyone who has prepared an Autochrome stereoscopic transparency must have asked himself the question, From which side, film or glass, should the stereograph be viewed? Should the pictures be reversed as usual in stereoscopic work, or can the undivided plate be employed? These doubts arise from the fact that the Autochrome differs so absolutely from the ordinary transparency. The plate is exposed through the glass and afterwards converted directly into a positive, a process which must be considered when using the plates for stereoscopy. Every beginner knows that in making an ordinary stereoscopic transparency the picture taken with the left-hand lens must be viewed with the left eye, and *vice versa.* Nothing seems easier, therefore, than doing this in the case of Autochrome exposures made on a single plate. Without cutting the plate—*i.e.*, without exchanging the right-hand and left-hand print—the pictures are brought into position by turning the plate longways. The right-hand print is then before the right eye, and the left-hand print before the left eye, and the glass side of the transparency is towards the observer. If such an Autochrome is observed in the ordinary stereoscope, there is obtained, it is true, a result possessing the effect of solidity, provided, of course, that the separation of the lenses is a good deal greater than that of the taking lenses. Yet the stereoscopic effect is not really stereoscopic, but only pseudoscopic. In reality the more distant objects appear nearest, whilst those really nearest appear rendered remote. It is a curious fact that many people cannot distinguish this pseudo-stereoscopy from the natural effect until the difference is carefully pointed out to them. The fact, however, teaches us that the uncut Autochrome stereoscopic transparency should not be used even though the proper image appears before each eye of the observer. The separate images must be reversed in position, yet not in such a way that the left-hand print is brought before the right eye and *vice versa.* There is, therefore, nothing else to be done than to cut the plate down the middle and to arrange the two plates with their film sides facing the observer, when a correct stereoscopic effect is obtained. The rule may be very simply explained thus:—Reverse the positions of the two pictures and view them from the film side. If the two prints are exchanged, but viewed from the glass side, the effect obtained is stereoscopically correct, but in this case the version of the original seen is obtained reversed as regards right and left—the picture which one would see in a mirror.

In order to understand the principles upon which this rule is based it may be well to consider the case of a very simple object of a diagrammatic kind. Let us assume that we are looking with both eyes at two points, one higher H and one lower N. Let the higher one be further removed and more to the right in comparison with the lower—that is to say, the letter H is higher and further back, whilst N is lower and nearer to the observer. If a glass plate be held some distance from the eyes, O_i O_l and O_r the state of things is that shown in fig. 1. If the left and right eye be alternately shut, it will be seen that for the left eye the lower point appears directly to the right under the higher point on the glass, whilst with the right eye the lower point is shifted to the left from the higher point.

The two images which we should thus see on a glass plate have the arrangement shown in fig. 2. The points in a finished stereoscopic print would be arranged in exactly this way in order to give the stereoscopic effect on observation with two eyes. Thus it will be seen that the image seen by the left eye can be distinguished from the other by the fact that in it the two points are almost exactly perpendicularly one above the other.

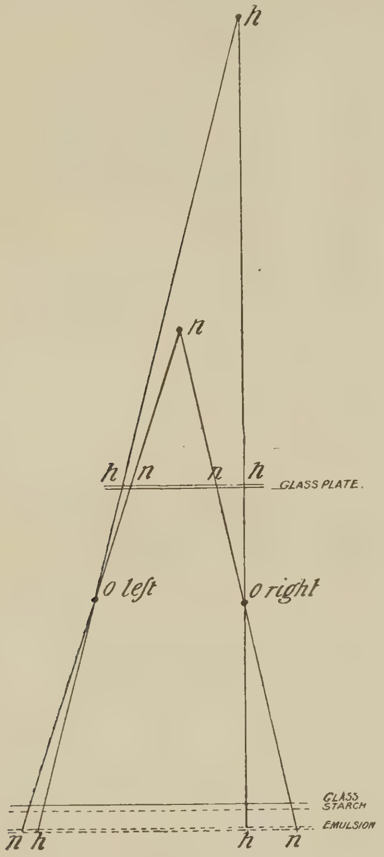

Fig. 1.

Assuming now that the two points are to be obtained upon an Autochrome plate. In fig. 1, in place of our eyes, we imagine two lenses, O_l O_l O_r at suitable distance, behind is the Autochrome plate, glass side to the lens. If after exposure, development, and so on, the finished plate is placed in the same position as that which it occupied at exposure, the two pictures are seen, of course, upside down, but the right-hand one is behind the right-hand lens and the left-hand behind the left-hand, as represented in fig. 3. If we turn the plate upon its long axis, so that the glass side is towards us, the pictures are upright, and in the right position to correspond with the arrangement of fig. 4, but not with the desired arrangement of fig. 2. In order to obtain this it is easy to see that the plate must be cut in half, and each plate separately turned on its vertical axis, when the arrangement of the points is correct and the film side of the plate is towards it.

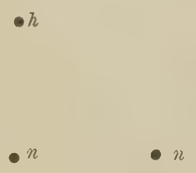

Fig. 2.

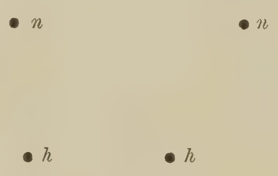

Fig. 3.

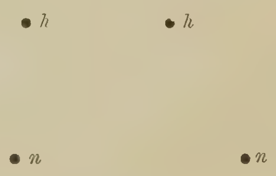

Fig 4.

Cutting the Plate.

The sizes of plates commonly employed for stereoscopy are 12 by 16 cm., 9 by 16 cm., and 10 by 15 cm., and in the event of Autochrome plates of these sizes being unobtainable it is necessary to use either two 9 by 12 plates or one 13 by 18; in either case the total breadth is 18 cm. If the finished transparency is to be viewed in an existing stereoscope, the separation of the distance in each picture must be made to suit that apparatus. The most simple way of going to work is by aid of an existing stereoscopic print, which gives a good stereoscopic effect in the apparatus without fatiguing the eyes.

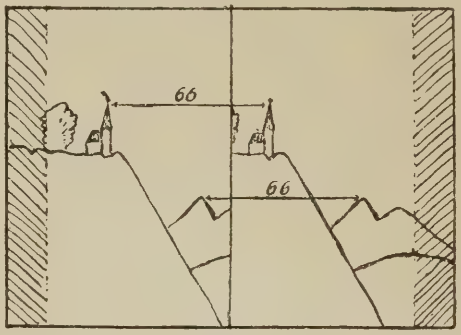

Fig. 5.

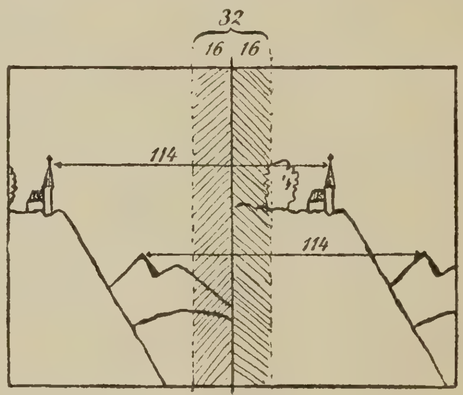

Fig. 6.

Fig. 6.

A print should be chosen which contains distant objects, and is one in which these objects do actually appear distant when viewed stereoscopically. The separation is then measured between two corresponding points of the distance, and may be called *a*. On the uncut Autochrome negative a measurement is likewise made of the separation of corresponding points in the distance, these latter corresponding to the separation of the lenses and being called *b*. These two data enable us to carry out the rule that from the whole breadth of the plate

(18 cm.) a portion equal to 180, *a*, *b*, must be cut off. In other words, add the separation of corresponding distant objects of a good stereoscopic print to that of a similar separation in the negative and subtract the total from the full breadth of the negative (18 cm.), the remainder gives the amount which must be cut off. For example, the separation of a good print was 82 mm., the actual separation of the lenses was 66 mm., consequently the amount to cut off was 180 – 82 – 66 = 32 mm., or 16 mm. from each separate print. The total picture before any trimming is carried out is in the condition represented diagrammatically in fig. 5. If the plate is cut down the middle and the picture reversed, the separation of the distance will be 180 – 66 = 114, as shown in fig. 6. But as the stereoscope requires a distance of 82 mm., a further amount equal to 114 – 8 – 2 must be also cut off, as indicated in the figure. Fig. 7 shows the finished plate. The trimming of the plate to these dimensions may, of course, be done before cutting down the middle, the portions to be trimmed off being situated at either end. From the formula $180 - a - b$, it follows that the best use is made of the plate the closer the value $a + b$ approaches 180. If, therefore, the stereoscopic camera or the stereoscope allows of alteration of the separation it is an advantage in making full use of the Autochrome plate. Should, however (which is not very likely), the total of *a* and *b* be greater than 180 there is, of course, then no portion to be cut off, the component pictures are placed a little further apart after the positions have been reversed. The fixing of the component pictures in their correct position can be done in many ways, conveniently by means of frames somewhat similar to those supplied for stand development, or the separate portions of plate may be bound to a clean 13 by 18 glass plate and the four corners secured with a few drops of seccotine. All the foregoing instructions for trimming are only addressed to the beginner who is anxious to obtain the full stereoscopic effect of his prints.

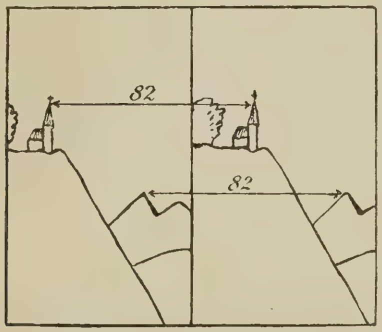

Fig. 7.

The Question of Grain.

The grain of the Autochrome plate, which to the unaided eye is fairly visible, is often enlarged to an unpleasing degree by the magnifying lenses of the stereoscope, which when of a focal length of 100 to 150 mm. give about a double enlargement. It is, therefore, advisable as far as possible to make use of the least degree of enlargement—that is to say, to choose lenses for the stereoscope of long focus, and in order to retain the geometrical truth of the stereoscopic effect it is likewise advisable to choose a pair of lenses for taking the stereoscopic negative also of corresponding length of 18 to 25 cm. in place of 9 to 15 cm. which are customarily employed.

This choice of longer focal length for both descriptions of lens is a further advantage which is connected with the character of the Autochrome plate, and does not apply to other stereoscopic transparencies. This lies in the fact that while the exposure is made through the glass the transparency is viewed from the film side. The direction, therefore, in which oblique rays fall upon the starch grains and emulsion at the time of exposure does not correspond with that in which the rays pass through the film when the plate is observed in the stereoscope. In Fig. 8 an exaggerated representation is given of a marginal portion of an Autochrome transparency in which oblique rays are falling on the plate. It is seen that the portion which appears actually red may appear green to the eye. This difficulty is got over by looking at the positive through the glass, but the picture is then reversed.

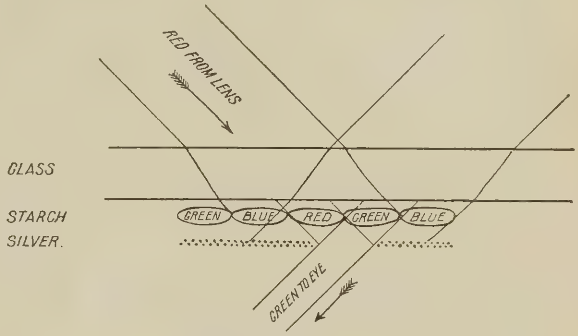

Fig. 8.

The use of lenses which do not include a wide-angle as well as those which work at a comparatively small aperture is to be recommended not only on the ground of small enlargement of the grain, but also on that of colour-correctness. That such errors may come in with unsuitable choice of angle can be shown by an experiment of the kind outlined in Fig. 8. A negative is taken with a short-focus lens, and a lens such as that of the "Verant" of the same focal length used for the observation of the finished transparency, when a distinct improvement of the colour will be seen towards the edges of the field by looking at the picture, not from the film side, but through the glass.

R. LUTHER.

AUTOCHROME ITEMS.

Stained Hands in Autochrome Work.

A WRITER in "Wiener Mitteilungen" refers to stains on the fingers as a source of trouble among Autochrome workers, although the fact appears to be ignored by such complainants that the silver stains produced by the intensifying solutions have their remedy at hand in the shape of the permanganate employed for the reversal and clearing of the plates. As humorously pointed out by Mr. T. K. Grant on the occasion of his demonstration of the Autochrome plate at the Royal Photographic Society, any trouble in the way of stains is experienced only when the fingers are allowed to come in contact with a few of the solutions, not with all of them. This in effect is exactly the recommendation of the Continental writer who advises treatment of the stained skin with the acid permanganate bath, followed by a short rinse and immersion in the acid fixing-bath. This latter should have a distinct odour of sulphurous acid; if it is deficient in this respect a little potassium metallic sulphite may be added.

Stripping Autochromes.

Dr. W. Scheffer, whose skill as a microscopist has been evidenced by his remarkable series of photographs of sections of photographic plates, writes in the "Photographische Rundschau" as to the most suitable reagent for the removal of the Autochrome film unaltered from its glass support. The best means for this purpose he finds to be pure xylol. An Autochrome plate allowed to remain for a day or two in this liquid separates completely from its support, the xylol apparently dissolving only the cement which is employed to attach the layer of starch grains to the glass, and leaving the other parts of the composite Autochrome film unaffected. This action, however, is found to be slow, as the liquid reaches the film only under the edges.

Temperature in Development.

Baron von Hübl, in the course of an article in a recent issue of the "Wiener Mitteilungen," refers to cases in which the acid amidol developer, containing a fairly liberal dose of bromide, was employed in place of pyro. The results, although exposure had been correct, were flat and lacking in vigour, and without the usual excellent range of colours. Moreover, the plates lost density in the fixing-bath. In another instance a plate developed with the normal pyro developer on a hot day was found to give a result almost destitute of colour. An abnormally high temperature was found to be the cause of these irregularities, perfect results being obtained under similar conditions when precautions were taken to cool the baths.

COLOUR PHOTOGRAPHY AT THE GRAFTON GALLERIES.

THE members of "L'Entente Cordiale" (Anglo-French Association) had a treat on the afternoon of Saturday, the 31st ult., when Monsieur Meys, of the "Illustration," lectured on the Autochrome process and presented to them a large selection from his 800 Autochrome pictures. Unfortunately, M. Meys had not brought his own lantern with him from France, and the use of one which only took slides 3¼in. square to show plates 9 by 12 centimètres led to an absolute massacre of the pictorial composition, which is so strong a point of M. Meys' work. In spite of this, of the weak and yellow light of an old type of limelight lantern and of the daylight which crept through the window blinds, the audience evinced great satisfaction with many of the slides.

After an introduction on the early history of colour photography and a sketch of the manufacture and principle of the Autochrome plate, M. Meys showed us what he can do with it. Of the many pictures, the sunsets received the most applause. Excellent in colour was a child picking poppies in a field. A sunset on the water, with the sun just clear of the horizon, and a cutter entering its reflection, had only two or three seconds at $f/6$. M. Meys' own portrait sitting in his studio had one minute with the same stop.

The lecturer pointed out with pride the similarity of the colour rendering in some of his coast scenes with that of Cazin's pictures of the same country. The ruddy complexions of a group of elegantly dressed persons in a wood was facetiously pointed out as being a very true rendering of the exhilarating effects of an excellent champagne picnic. The shortest exposure mentioned was one second at $f/6$, for an open and country road with children in bright dresses The skies were mostly cut out by the smallness of the lantern, but a cathedral exterior showed a fine cloud effect. A woman raking in flowering orchard was much applauded, as was also a fiery sunset at Cannes, and some finely bound antique books, one of which belonged to Diana of Poitiers, and a very vivid group of azaleas. Red parasols as a background for *contre-jour* portraits are very effectively used. M. Meys pointed out how, in a charming picture of a little girl among red geraniums, the face, though seen against the light, was full of modelling, though in a monochrome picture it would probably be almost black. He instanced this transparency of the shadows as a characteristic of the Autochrome plate. A very fine sunset picture showed boys digging on the sands, while the glint of the setting sun on the windows of the houses in the background and its reflection in the pools of sea water were most convincing. A very delightful and unaffected picture showed a little farm girl in a red kerchief with her arms round the neck of a cow.

A girl at a table, lighted only by a petroleum lamp with a red shade, told a tale of endurance. The girl sat for twenty-two minutes. The result was excellent. Some Paul Potter-like studies of cattle included one of a bull, which had required three hours to obtain without exposing the operator to undue risk. Some large red buoys were very vivid in colour. The last slides showed some very fine sunset effects, of one of which M. Meys said that a well-known painter, seeing it, had said that he should be proud to sign so fine a piece. The lecturer concluded with a tribute to the genius and indefatigability of the Brothers Lumière. A hearty vote of thanks was given, in response to a cordial speech in English from the chairman of the council, Mr. Barton Kent, who had opened the proceedings in faultless French.

J. C. W.

THE SOCIETY OF COLOUR PHOTOGRAPHERS.

ANNUAL MEETING.

THE annual general meeting of the Society of Colour Photographers was held on October 29, at the Office of the "British Journal of Photography," Mr. A. J. Newton in the chair. Among those present were Messrs. E. J. Wall, E. D. Doncaster, A. W. Everest, P. B. Tubbs, C. W. Aston Key, W. T. P. Cunningham, F. T. Hollyer, Dr. C. E. K. Mees, Geo. E. Brown, and the Honorary Secretary, Henry J. Comley, F.R.P.S.

The annual report recorded an increase of membership of 25 per cent., and the statement of finances, a balance in hand.

The Secretary had placed his resignation upon the agenda paper, but stated he would be pleased to withdraw it if he could be relieved of the duties relating to the formation and circulation of the portfolios of prints and transparencies. On his nomination Mr. F. T. Hollyer was proposed as assistant as portfolio secretary, and was unanimously elected.

Mr. Hollyer becoming thus ex-officio a member of the committee, a vacancy on the committee was created by his election. To fill this Mr. E. D. Doncaster was unanimously elected.

The Honorary Secretary was again elected Treasurer.

Votes of thanks to Messrs. G. E. Brown and A. W. Brooks for assistance in connection with the annual exhibition of the Society, and to the auditors, Messrs. E. D. Doncaster and A. W. Everest, concluded the business of the meeting.

Correspondence.

⁂ *We do not undertake responsibility for the opinions expressed by our correspondents.*

⁂ *Correspondents should never write on both sides of the paper. No notice is taken of communications unless the names and addresses of the writers are given.*

THE LIGHT FILTER IN AUTOCHROME PHOTOGRAPHY.

To the Editors.

Gentlemen,—May I be permitted to call attention to an often repeated error in connection with Autochrome photography, which has received the support of Mr. Alfred Watkins in the "B.J. Colour Supplement" for October?

Mr. Watkins says: "If the light filter is fitted behind the lens, no allowance need be made in focussing for the fact that the plate has to be placed in the dark slide with the glass side facing the lens."

This statement is absolutely misleading, and may lead (as similar statements have in the past) to a considerable waste of valuable plates. If the compensating filter is placed behind the lens the focus of the lens will be lengthened to some extent, whether sufficiently so to compensate for the thickness of the Autochrome plate or not, we need not pause to consider; the point is, that in focussing we bring the ground side of the focussing screen into the plane where the rays of light come to a focus, and if a sharp picture is required the emulsion side of the Autochrome plate must be placed in the same plane. Cameras are usually constructed with the ground side of the focussing screen towards the lens, and the dark slides are fitted so that the outward side of the sensitive plate shall be in register with the focussing screen. If the plate is placed in the dark slide with the sensitive surface inwards, as is the case with the Autochrome plate, then some compensating adjustment of the focussing screen must be made, whether the yellow filter is in front of or behind the lens.

The only conceivable set of circumstances in which Mr Watkins's statement could be accurate would be in the case of the photographer focussing without the screen and then fitting it behind the lens. If then the focus is not mechanically disturbed by fitting the filter inside the camera, and if the refraction by the filter is equal to the displacement of the sensitive surface by the plate being put in position hind side before, then no doubt the image will be in focus; but the photographer who wishes to run no risks of failure will be wise to focus with the screen in position, whether he uses it before or behind the lens, and to bear in mind that the statement referred to above can only be true under exceptional circumstances.—I am, yours obediently,

J. M.

No. 24 Vol. II. DECEMBER 4, 1908.

THE BRITISH JOURNAL OF PHOTOGRAPHY

MONTHLY SUPPLEMENT

ON

Colour Photography.

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THE "THAMES" ONE-EXPOSURE COLOUR PROCESS.

The long-looked-for "Thames" plate having at last appeared upon the market, some account of its use, and notes on personal experiences, will probably be of service to readers of the "B.J." At the start we may as well say that we have been rather agreeably surprised at the results we attained in our first experiments, in spite of the fact that neither the plate nor the procedure have as yet been brought to perfection. The process is most interesting, and quite simple, the only material difficulty being the registration of screen with the finished positive. The procedure is longer than in the case of the Autochrome, but still, a finished result can be produced in two hours, or even less, without any undue haste. The final results are different from Autochromes, and cannot be judged from quite the same standpoint. Their relative value will be better determined when we have had more experience, but one feature of the "Thames" plate is the fact that the results are probably at their best when viewed by artificial light. Those with experience of the arrangement of illuminating devices for viewing Autochromes will realise that this is not an inconsiderable advantage.

Exposure.

At present the screen and sensitive plate are issued separately, and in loading the slide we first place the screen-plate in the rebate with glass side towards the shutter, and then lay upon it the sensitive plate film side down, so that film and colour-screen are in contact. We are then told to place a piece of dead-black paper over the whole before closing the slide; but in regard to this advice we are much inclined to think that it would be far better to use backed plates. For exposure a compensating filter is used at the lens, and in the absence of a proper filter we experimented with Wratten K1 and K2 screens, and also with the Lumière filter. Owing to the fact that the screen-plates at present supplied vary greatly in colour, it is evident that no one particular screen can be correct for all cases, and it was probably owing to this irregularity that we found less difference than expected between the results when using either the K2 or the Lumière filter. Apparently the K1 filter is too light, and K2 seemed to give the best colour rendering. The Lumière screen also worked very well in some cases, but not in others. The irregularity of the screen plates makes it just as difficult to arrive at correct ideas with regard to exposure as it is to recommend the best screen; but with the Lumière screen we obtained good clean results by taking the speed of the plate as 16 Watkins for indoor subjects. This means that at *f*/11 the exposure is equal to the time that a Watkins quarter-tint takes to darken. If the speed of the Autochrome is taken at 1, under the same conditions, the required exposure is about 2 full tints at *f*/8, and from this it would appear that the "Thames" plate with Autochrome screen is about 16 times as fast as the Autochrome plate. With the K2 filter the "Thames" plate appears to be rather slower—possibly about 8 times the speed of the Autochrome. One full tint at *f*/8 seems to give about the right result. If exposure is calculated on these bases, the K2 filter gives much the best colour rendering; but in our experimental exposures we also obtained some fairly accurate results with the Autochrome screen. The times of exposure and of development, and the

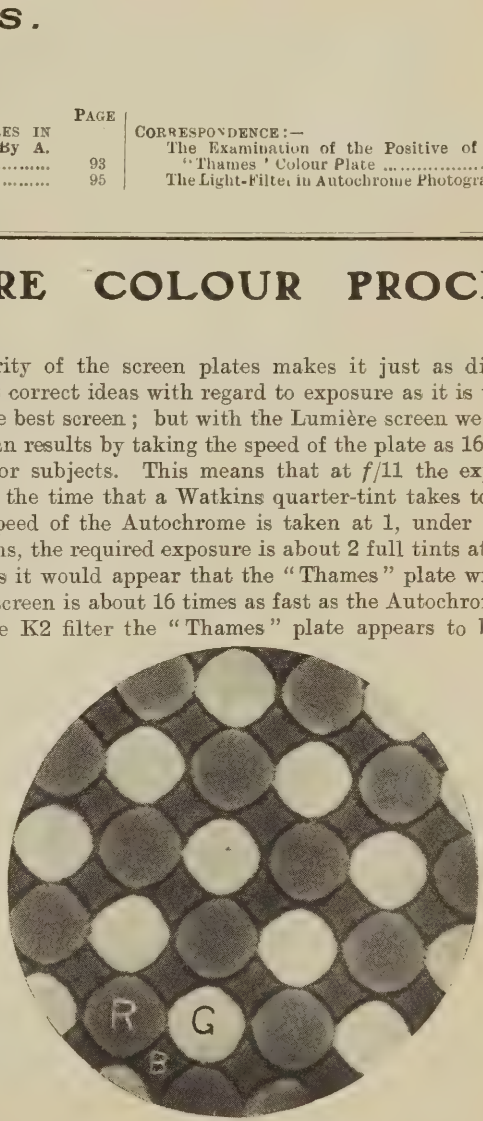

Fig. 1.

Photo-micrograph of "Thames" filter-plate, photographed at 200 magnifications. As the reproduction is half-scale, the above represents a magnification of 100 diameters. By J. H. Pledge.

density of the final result, are all factors that seem to affect the colours, and so until the screens and filters are standardised it is impossible to give very exact instructions for the method of obtaining correct colour representation. We may add that most of our exposures were made in dull light between the hours of 12 a.m. and 3 p.m. The light was just good enough to produce fairly good Autochromes, but not good enough to give brilliant results. In connection with the speed question, we note that the makers give 12 H. and D. as the speed of the plate, which nearly corresponds with the 16 Watkins that we worked to with the Autochrome filter.

Development.

After exposure the plate is developed in the following:—

No. 1.—	Hydroquinone	½ oz.
	Potass. metabisulphite	½ oz.
	Water	20 ozs.
No. 2.—	Caustic potash	1 oz.
	Water	20 ozs.

Equal parts of Nos. 1 and 2 are taken for use, and the time of development is given as three minutes. We understood this to be the time for normal temperature, and as the effect of hydroquinone varies greatly with temperature, we made allowance for cold solution with the aid of a Watkins thermo-indicator. Four minutes gave good results at a temperature of 55 deg. F. Though the developer contains no bromide, it gives remarkably clean results, and shows no tendency to produce fog.

Reversing.

After development the plate is washed for one minute under the tap, and it is then immersed in a fresh 10 per cent. solution of ammonium persulphate for a minute, again washed for a minute, and then put in the reversing bath, which is made up as follows:—

A.—	Potass. permanganate	36 grs.
	Water	20 ozs.
B.—	Sulphuric acid	160 mms.
	Water	20 ozs.

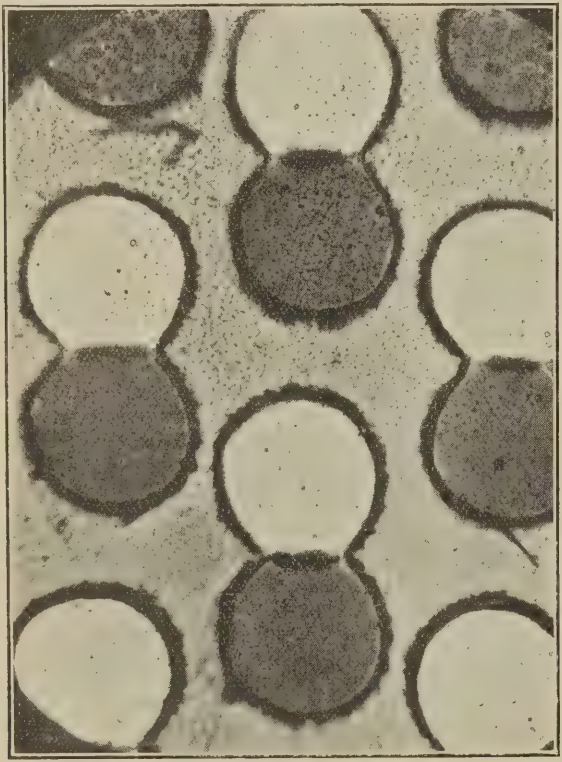

Fig. 2.

Photo-micrograph of "Thames" plate Batch No. 1, showing dots joined together; 322 magnifications on Wratten Panchromatic plate. Reproduced here same size. By J. R. & G. R. Lynch.

Equal parts of A and B are taken, and when the plate is immersed the light is turned up, and the completion of the reversing process is judged by inspection, just as in the Autochrome process. This reversing solution is practically the same as that used in the Lumière process; and, as we had the latter ready, we used it in preference to mixing up a new formula. The method of reversing described gives very clean and good results, but the object of the persulphate solution is not quite clear. It would be an advantage if the extra solution could be dispensed with; but we had not sufficient plates at hand to enable us to test the effect of its omission.

Second Development.

After reversal, we are instructed to develop in the following solution:—

Sulphite of soda	¼ oz.
Water	10 ozs.

To 2 ounces of this add 6 grains of amidol and 2 drams of a 5 per cent. solution of potassium bromide. Nothing is said about washing at this stage, but, acting on past experience with Autochrome plates, we washed for a minute under the tap, and then cleared out the last of the permanganate stain with very dilute acid sulphite solution before developing. The developer given above works rather slowly, and does not give full black tones. It acts very regularly, but tends to give a rather weak image. The amount of bromide it contains seems to be rather excessive, and we several times obtained better results by employing the first developer (hydroquinone) instead of the amidol. On another occasion we intensified the amidol-developed image, with the result that the colours of the completed result were greatly improved. The re-development is stated to take 4 minutes, but we found that a much longer time was required with the heavily restrained formula. After re-development the plate is fixed, washed, and dried, and then we meet with the most troublesome and difficult part of the whole process—that is, the registration of plate and screen. The developed image is not

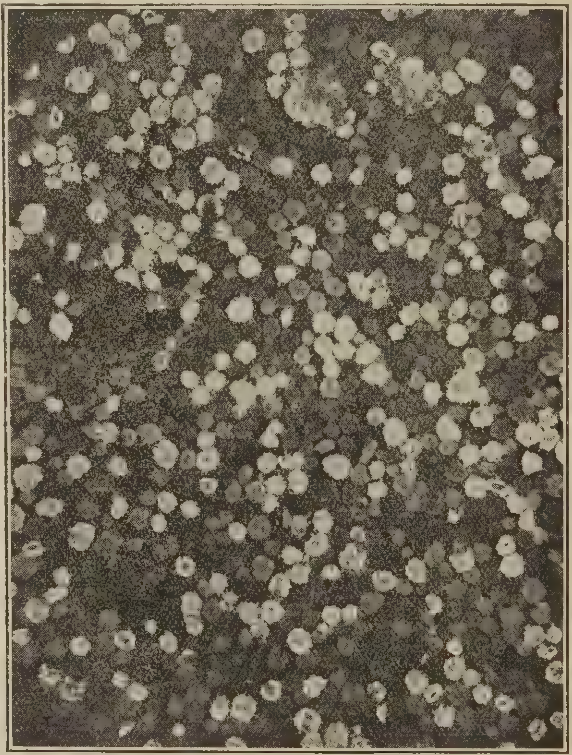

Fig. 3.

Photo-micrograph of Autochrome starch-grain plate, same magnification (*i.e.* 322) for comparison. On Wratten Panchromatic by Nernst light. By J. R. & G. R. Lynch.

like an ordinary full-tone positive, but rather resembles a half-tone impression. There should, of course, be no clear glass in it.

Registration.

The screens are provided with registration marks, in the form of scratched-in crosses, which marks, by the way, spoil rather more of the plate than they need. They might be placed much nearer the margins and the corners. From the instructions, it would appear that it is only necessary to fit the registration marks, fix the plates together temporarily with clips, and then bind up; but we found that in practice the matter was not quite so simple. We used a special colour chart as a test, with all the colours marked, so that there could be no doubt as to the correctness of the result; and it appeared to be quite possible to have the whole of the colours wrong without any appreciable displacement of the marks. A small subject occupying only a small part of the plate is easily registered, but when the whole plate is covered with subjects it is not at all easy to get the whole of them in exact register at once. Sooner or later we reach a stage where the whole of the colours, with only a few exceptions appear to be just right, and then the attempt to correct the few exceptions, disturbs the rest. It will be found that some colours are reproduced perfectly when the register is quite wrong, but the screens are not sufficiently uniform to permit perfect results being attained in all parts, excepting when the positive image is exactly registered with the particular screen used in exposure. As will be seen from the photo-micrographs of J. R. and G. R. Lynch, the screen-dots vary considerably in size and situation; therefore, nothing but a perfectly regained register can give correct results. So far we have not been able to find any short cut to perfect register. The only recipe is plenty of patience. It must be remembered that it is quite possible to get all the colours nearly right, though none may be absolutely so. An extremely minute uniform shift is then necessary, and the difficulty is, of course, to determine the proper direction of that shift. It is naturally easy to determine when the register is correct with a test chart such as that described, but with natural subjects it is obviously necessary to have a very true eye for colour and a correct knowledge of the colours of nature. A very minute displacement will spoil all the half-tones and broken colours, and, as before stated, it is quite possible to get a few prominent features nearly correct while the rest of the picture is quite wrong. It is evident from our experiences that the separation of screen and plate is a weak feature in the "Thames" plate. The results that can be obtained with the two plates, however, show clearly that much may be expected from the single screen-plate that is promised in the near future, and until we get these it is hardly fair to attempt any comparison between "Thames" plates and Autochrome plates. A minor trouble with the double plates is the fact that the ordinary dark-slide rebate is not deep enough to take two plates easily.

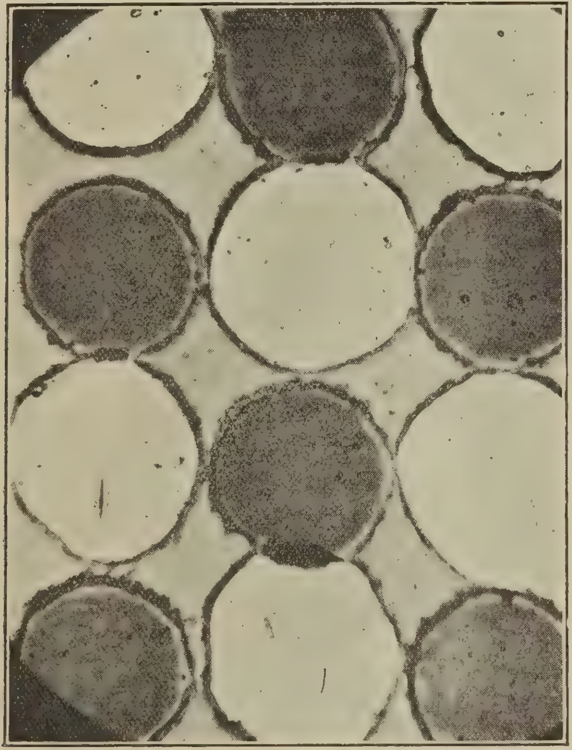

Fig. 4.

Photo-micrograph of "Thames" Plate, Batch No. 1, showing dots correctly separated by under surface; 322 magnifications on Wratten Panchromatic plate. Reproduced here same size. By J. R. & G. R. Lynch.

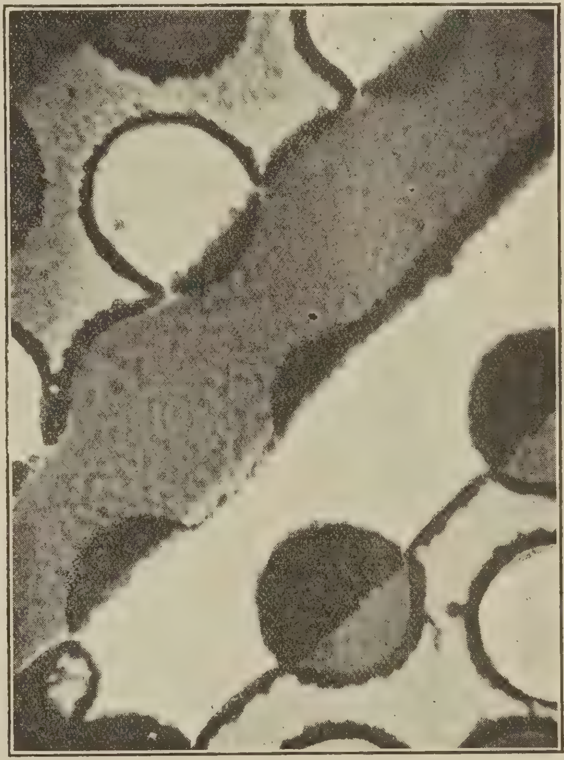

Fig. 5.

Photo-micrograph (322 diameters) of "Thames" plate, showing a point in screen where colour has run. Taken on Wratten Panchromatic Plate. By J. R. & G. R. Lynch.

The Colour Rendering.

As already stated, we have obtained very true colour rendering with both the Autochrome filter and the Wratten K2 filter; the truth, however, was not universal in all colours. We have not succeeded in directly producing either a good purple or a good pure yellow, though indirectly both colours have appeared in the wrong places as a result of incorrect registration. This shows that the plate is not incapable of rendering the colours, so we may conclude that, as with the Autochrome, the appearance of certain colours depends very considerably on exposure. A good range of blues seems to be attainable from green-blue through ultramarine to indigo, and also a fair series of reds from orange through vermilion to crimson. A deep red, however, we have not seen. Greys and greens seem to tend to the blue side, but the browns we have tried have come out very well. As a matter of fact, the colour rendering was far better than we expected to find it, considering the variations in the screen tints and our haphazard selection of filters. It may, by the way, be useful to mention that the example of good colour rendering that we obtained with the Autochrome filter was made through a screen that is distinctly blue all over. The best result with the K2 filter was made through a screen of a decided pink colour. These results were not quite what we should have expected, and possibly a good deal depended upon a happily adjusted exposure in the case of the Autochrome screen.

A little difficulty sometimes occurs when attempting to identify the screen with which a particular plate was exposed. At present we can more or less identify our screens by the various scratches which deface them, but with perfect screens some trouble might be met with. We suggest that every screen should be carefully marked with a number scratched in the screen coating in such a way that it may print on the plate. The user, of course, should see to this. Another source of trouble is the fact that screen and plate seldom fit edge to edge in the dark-slide. When the time comes for registration it may be found that the one plate must be set at an angle to the other to secure the proper adjustment, and this is, of course, very awkward for the binding operation. A simple remedy is to roughly bind screen and plate together with lantern-slide strips or stamp-paper before loading the dark slide. This may be a little extra trouble at the start, but it saves a great deal of trouble at the finish.

The photo-micrographs by J. R. and G. R. Lynch, and by J. H. Pledge, that accompany this article are self-explanatory. They show very well the varying sizes and arrangements of the dots on the "Thames" plate, and also the relative scales of the colour units, compared with those of the Autochrome plate. Mr. Pledge's particularly well shows the relative brightness of the filter elements. It must not, however, be forgotten that the colour units or starch granules of the latter plate are invisible to the eye, and that the "grains" that we see when examining an Autochrome are not the separate granules, but agglomerations of them. The difference to the eye is, therefore, not so great as the photo-micrographs may appear to indicate. As a matter of fact, the appearance of the finished "Thames" plate is very much that of a half-tone engraving in colour made from a medium grain screen. The black rings that appear around the "Thames" plate dots in the photographs are somewhat difficult to account for. They may be due to the overlapping of the dyes, but more probably they are optical effects, due to the fact that each dot is really a depression, or little pit, in the film of the screen-plate.

FURTHER EXPERIMENTS WITH THE "THAMES" PLATE.

[In the following article Mr. H. Essenhigh Corke advises the employment of the "Thames" filter plate on the lines adopted in the Joly and MacDonough-Joly processes, namely, the making of a negative colour-record through the mosaic screen, the printing of a positive transparency, and the registration of this latter with a mosaic filter-plate. It must, however, be pointed out that this system is limited in its application to plates of small size, owing to the difficulty of obtaining proper contact over the whole area of larger plates, and also involves errors due to parallax to a greater extent than with a screen-plate proper.—Eds. "Colour Photography" Supplement.]

Since my article upon this subject (in the "B.J.," November 20, 1908), I have devoted considerable time to the process, and have achieved results which lead one to think seriously of the large fields of work in this process. In the first place, I should like to state that I have received very courteous attention from the Thames Plate Company. Whilst they have afforded me every facility to make numerous experiments, by keeping me well supplied with plates (although, I believe, their resources are taxed severely to meet the present demand), yet the actual materials supplied to me have not been specially made or selected, but picked at random from their stock.

I mentioned in my last notes that the screens which I first obtained were unevenly inked, and varied also in their visual colour, but I am assured that this difficulty has been finally overcome, by the further knowledge and experience already gained in the manufacture. All the screens which I am now using are perfectly evenly inked, and of a much more neutral tint when examined by the naked eye. This regularity is no doubt also the reason that my later results are a great improvement also in the matter of correct colour rendering. My estimate of the number of dots and interstices per square inch, the makers point out in your last issue, is incorrect. They estimate the number at 67,500 per inch, instead of, as I estimated, 19,200. A very great difference, surely; but as the makers no doubt know the correct numbers, and I have not yet had time to make further careful microscopical counts, I must leave this point until another time. Yet the actual numbers are not of much consequence, as the results will conclusively prove that the grain, when viewed by the eye, is not in any way obtrusive, and unless one's attention be deliberately called to it, would perhaps not be noticed at all; and, in fact, so long as the grain is not obtrusive then the larger the dots the better for some reasons. It seems feasible that if ever a bleach-out paper similar to "Uto" is successfully introduced a larger or coarser grained positive would be easier to work from than a fine grain. Also, in this particular respect the flat dots of the "Thames" would tend, I think, to more perfect colour-rendering than spheroidal grains, such as in Autochromes, which must to a certain extent refract the light passing through them. The comparisons which I made in the size of "Thames" dots with Autochrome grains as regards size still, I think, stands as correct.

The process and method of using the "Thames" plate give rise to several trains of thought, as to the practicability and application of such work in the future, and, broadly speaking, these may be considered under two main heads.

As regards the commercial application of the "Thames" plate, it is essential that the process employed, besides being capable of control and modification, must also be one that allows duplicate copies to be made with ease, quickness, and truthfulness. My own experiments in this direction prove, I think, that with a fuller knowledge and experience the process will be able to thoroughly fulfil all these requirements.

The first experiments made were to try and simplify the working formulæ. My idea was to try and produce instead of a positive, a negative from which duplicate positives could be made in any quantity, which would only then require binding up in registration with extra colour-screens to produce colour transparencies. As the makers' formula for the first developer, as under, is rather more trouble to make up than some of the more usual, I have made trials with various others, such as pyro-soda, Rodinal, and finally have selected the following formula, which I have prepared, and give in its correct strength. My suggested amidol formula will be found to give equally good results, and can also be used for developing the final transparencies:—

Diamidophenol	50 gr.
Soda sulphite	1 oz.
Water	10 oz.
Potass. bromide, 10 per cent. solution. ...	10 drops.

After development for three minutes in this developer, the plate is transferred to an acid fixing bath, fixed, and washed as usual. When dry, a transparency is made by contact, and for normal exposures the best results I have were made upon "Imperial" special lantern plates H. and D. speed 7. No doubt any other slow plates could be used with equal success. This method thus gives us the means of producing as many transparencies as we like from the one original negative with great ease and certainty. The results being in every way as good as those made by reversing the negative. One or two portraits I have made are very successful so far and the flesh tones distinctly good. The only thing required besides a few ordinary plates is a separate colour-screen for each final result, and although at present the Thames Plate Company can only cope with the usual orders, no doubt in time they will respond to any demand by supplying the screens separately.

By this negative and positive method we obtain our control. If, for instance, we have an original negative which is too flat or soft, we can by careful selection of our plate and careful development control our final results to almost any degree of crispness and pluck. If, on the other hand, our negative is too dense or hard, due most likely to too much development, we may make our final transparencies upon a fast plate, and thus obtain much softer and more subtle results. This is particularly noticeable in one of my results, which is made upon a Marion's "P.S." plate, H. and D. speed 240.

Although I have not at present had opportunities to make actual tests, it also appears feasible that we could, to a certain extent at any rate exercise local control by means of much the same method as are in use for monochrome work. Supposing that a certain patch of colour was too intense, we could, by the ordinary methods of control, by matt varnish, etc., keep that patch less intense in our final results..

I hear that many workers and more especially those who have not yet actually tried "Thames" plates, fear that the registration is a difficult matter, and I would like to be able to dispel that false idea. The registration is really simplicity itself, and calls for only a very ordinary amount of care.

But I am informed that the makers hope to bring out soon a combined plate and screen, although I hope they will still sell and make separate ones for the benefit of those who adopt my method.

H. Essenhigh Corke.

THE COLOURS OF AUTOCHROME PICTURES IN REGARD TO THEIR PRODUCTION.

[Baron von Hübl, in continuing the discussion of the properties of the Autochrome, which was translated in the "Colour Photography" Supplement of November 6 from the "Wiener Mitteilungen," proceeds to deal with the characteristic features of the colours in an Autochrome plate from the point of view of their reproduction, either on another Autochrome plate or by an available paper printing process.—Eds. "Colour Photography" Supplement.]

In the previous portion of this article the colours of the Autochrome pictures were characterised as follows:—(1) Autochrome colours may be regarded as pure colours lying on a grey and not perfectly homogeneous substratum, on which account they appear feeble or blackish. (2) The colours are invariably somewhat whiter than those of the original, though their saturation is not uniformly reduced, different colours showing different degrees of saturation. These facts being borne in mind, it is easy to deal with the questions which come up in reference to the possibility of making reproductions of Autochrome transparencies.

Autochromes from Autochromes.

In preparing reproductions in this way the structure of the picture and the want of homogeneity in the colours, due to the distribution of the colour elements, have no effect. Even when a perfectly sharp copy is made, the light passing through the image is practically homogeneous, and the larger groups of uniformly coloured starch grains produce a slight cloud-like structure, which is only recognisable in the case of comparatively large open areas.

The view, which has been many times expressed, that by working in this way only muddy blackish colours are to be obtained, may hold good for screen-plates of coarse structure, but does not do so for those of the fine grain of the Autochrome. The truth of this can be readily seen by photographing, on an Autochrome plate, and by transmitted light, a series of coloured gelatine films, first with, and secondly without, a grain plate applied to them. The application of the grain plate communicates to the homogeneous colours the character of the Autochrome colours, yet the proper adjustment of exposure in the two cases will give precisely the same result in each. An Autochrome picture covered with ground glass can be printed either in a triple extension camera or by contact, but in the latter case the plate must be exposed to perpendicular parallel light in order to obtain sharp results, since the original is bound to be almost 2 mm. from the sensitive plate. In both cases the compensating yellow filter must, of course, be used.

Further, the blackishness or extra density, of the Autochrome has no effect whatever in preventing reproduction, whereas a whitening or weakening of the colours does produce a disturbing effect. The saturation of the already slightly saturated colours is further depressed, and thus the blue B of Fig. 1 in the previous article[1] is reproduced as the whitish-blue C, and the lens saturated yellow E is reproduced almost colourless. There thus result a flatter print from which the whiter colour tones of the original are almost missing.

In any case, a good deal depends upon the character of the original. An Autochrome which contains only full strong colours, from which yellow is completely absent, will give a very satisfactory result, whereas whitish soft colour tones, which are essential to the colour scheme, are quite useless for reproduction. Moreover, the defect inherent in every photographic process—namely, the tendency to obtain too brilliant lights and too dark shadows when making a reproduction—come in here as much as in ordinary monochrome photography. It is well known that photographic copies almost invariably exhibit a very appreciable loss of half-tone, and this defect is equally noticeable in the case of copies of Autochromes. The first colour exposure is, we will say, perfect, and the above-mentioned defects scarcely noticeable, but on copying the unequal reduction of the saturation of the colours will be noticed, as also the loss in half-tone. This will be observed particularly when the enlarged copy is being made from an original, as in this case the structure of the Autochrome plate likewise comes into play, and as a result blackish colour tones are produced.

It will, therefore, thus be seen that the reproduction of one Autochrome from another is possible, but the somewhat complex juncture of conditions is against the copy corresponding with the original. Also, in printing from a negative Autochrome on to an Autochrome plate no actual principle of reproduction has to be violated, but in this case also the results are not equal to the original.

In order to prepare a negative Autochrome the exposed plate, after development, is simply fixed, and when behind this negative in complementary colours a second Autochrome plate is exposed, a colour-correct positive is obtained on development and fixation. The process is a very simple one, as all reversal with permanganate is dispensed with, and any desired number of similar colour transparencies can be easily obtained in place of the single positive result produced by reversal of the plate exposed in the camera. This latter process, however, gives us quite automatically a positive corresponding to the negative produced on exposure to light, whilst in the case of the printing process the modifications in gradation come in and prejudicially affect the colour result.

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[1] "Colour Photography" Supplement, November 6, page 84.

It is on this account that direct Autochrome results are incomparably better than those printed from Autochrome negatives, and there is evidently good reason why the discoverers of the process have confined their recommendations to the direct positive process in place of the apparently more attractive printing method. The cause of the inferior quality of copies of Autochromes is thus seen to be intimately connected with the properties of the sensitive photographic film, and it is therefore not probable that results with other colour screen-plates will be any better in this respect. On the other hand, the contrary is rather to be anticipated. The colours formed on a screen-plate of, say, linear formation will presumably possess all the properties of the Autochrome colours. They may, perhaps, be more transparent, but they will also be whiter, than the original colours, and possess defects of saturation, inasmuch as the mode of formation of the colours is the same in each case. Since, however, a line-screen does not permit of the fineness of the starch grains, printing of sharp copies from line-plates can scarcely be possible, it will be necessary to allow a certain unsharpness in order to obtain the colours homogeneous. In order to prevent this unsharpness from producing a too disturbing effect, the attempt is made in the Warner-Powrie process to limit it to one direction. The lines of the sensitive plate are laid at right-angles to the lines of the original, and the exposure is made by inclining the lines of the original to the light falling on the surface. The copy thus obtained is unsharp only in the direction of the lines, whilst in the direction at right-angles to the latter it preserves its sharpness. That it is necessary to use this method in printing from such originals can hardly be called an advantage of the line screen, and it is therefore difficult to see why such results, in contradistinction to Autochromes, should be designated "printable."

Prints from Autochromes on Bleach-out and Leuco Papers.

The want of homogeneity of the prints should scarcely form an obstacle to printing upon bleach-out paper, since the colour elements of the picture, on account of their small size, and on account of light falling upon the surface from all directions, will scarcely be separately reproduced in the print. Possibly a better homogeneity of the colours will be obtained by placing between the original and the paper during printing a thin film of gelatine. But, even if the print obtained resembles the original in that it consists of particles of red, green, and blue lying near to each other, a fairly passable result must still be obtained. These colour elements, when observed by reflected light, unite to form a continuous picture, just as when looked at by transmitted light, and the result will be a print which may tend to greyness, but would be otherwise (that is, in colouring) a quite correct copy. The basis of the bleach-out process is right in theory, since any colour is sensitive only to the rays which it absorbs—that is to say, is decomposed or bleached only by these. Unfortunately, the papers which have been prepared up to now are by no means perfect, for while they give, in the case of originals with open areas of colour—e.g., coloured prints or gelatine films—quite useful results, the reproductions are very far from satisfactory in the case of originals with soft gradations of colour. The essential defect of these papers is that the present sensitisers, anethol and hydrogen peroxide, are volatile and easily decomposed, and that thus the equal degree of sensitiveness of the three colours which the paper possesses at first is greatly altered during printing, and this defect is particularly unfortunate in the case of Autochromes, inasmuch as for these latter a very intense degree of sunlight is necessary, causing heating of the printing-frame and volatilisation of the sensitisers before the termination of the bleaching-out process.

The smaller the proportion of colour in the original—that is to say, the whiter or the blacker the tone—the more striking are the departures from the correct colouring in consequence of this defect. A dark screen, for example, when reproduced on a bleach-out paper, the components of which are not working equally, does not come out satisfactorily, and a light or whitish green may give rise to a quite wrong colour, even a brown or red. a perfectly transparent three-colour print is liable to give pale copies on the bleach-out paper, and the less saturated colours of the Autochrome print are still less favourable to the process. The film of the bleach-out paper is also of small senitiveness, whilst the Autochrome is of comparatively great density, and thus a uniform bleaching-out of the colours under such conditions is doubly difficult, since before the film has begun to bleach under the dark blackish tones the process has been completed under the brighter whitish colours.

Leuco Printing Methods.

Another process which has been recommended for the printing of Autochrome pictures on paper depends upon the use of the leuco bases.[2] These latter are fairly unstable white bodies prepared from dyes, and are of such a nature that on exposure to light they are reconverted into the original colouring matter. In this process rays of any colour are active which are absorbed by the resulting dye, and therefore the reconversion of the colours takes place particularly rapidly in light of the complementary colour. If a sheet of paper be coated with collodion containing leuco malachite-green, the colourless film becomes bluish-green in red light, since the resulting dye absorbs the red rays of the spectrum. If such a paper be exposed under a colour transparency, all the red portions of the latter, and obviously also all white portions, will be represented by blue-green. And in the same way the leuco bases of a yellow and purple dye will, when exposed to the complementary colour, become respectively blue and yellow-green, these colours being also produced under the clear parts of a transparency—that is, those transmitting white light. Therefore, if a mixture of the three leuco bases be coated upon paper, and the film exposed under a negative Autochrome, a positive in the correct colours will be obtained. This process, however, will only give passable results if the leuco bases are caused to become coloured strictly by the action of rays of complementary colour, which in practice is not the case. These colourless bodies are actually sensitive to the rays of the blue part of the spectrum, and when a certain colouring has been produced, the colouring matter formed acts as a sensitiser for those rays of the spectrum which it absorbs. In this way a second maximum of sensitiveness results, the original blue sensitiveness of the film also persisting.

Under these conditions a mixture of the above-mentioned three leuco bodies will give no useful result, and the printing process can be carried out only by dividing the three sensitive dyes, as was done in the case of the pinachrome process, afterwards superimposing the print. In the case of the Autochrome the collodion paper bearing the leuco blue body is exposed under the colour transparency, while the latter is covered with a red filter in order to limit the action of the light on the leuco paper to that of the red rays. After fixing the blue image thus obtained the print is coated with the leuco yellow, and then again exposed beneath the Autochrome, in this case with a superposed blue filter, and finally the purple component is formed, using the yellow-green filter over the Autochrome. This is obviously a roundabout and difficult process, and, as the leuco solutions are by no means permanent, and as the prints can only be incompletely fixed, it can scarcely be hoped that in this method the solution of the problem of colour photography upon paper is to be found.

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[2] E. Stenger and F. Leiber, "Colour Photography" Supplement, May 1, 1908, page 34.

Reproductions of Autochromes by Three-colour Printing.

The methods of three-colour printing require, as is well known, three separate exposures through different filters, and therefore in the case of natural objects, particularly living ones, are applied with difficulty and uncertainty. If, however, the three colour records may be made simultaneously upon an Autochrome plate, the subsequent dissection of the three records may be done at leisure, and away from conditions such as wind and weather, which may have precluded three separate exposures upon the object. Opinions upon the usefulness of the Autochrome prints for three-colour work are, however, still much divided, and whilst B. R. Russ[3] regards scuh prints as complete substitutes for originals, F. Leiber[4] considers the direct method from nature far superior to that involving the Autochrome. That the Autochrome, as regards its fidelity to the original, may be employed is universally admitted. Correctly exposed pictures properly treated leave scarcely anything to be desired as regards their reproduction of the colouring. There may be the saturation phenomena, already mentioned, but they are so inappreciable that they do not impair the truth and feeling of the picture. We thus come to the question as to whether such Autochromes may be successfully employed for the making of perfect three-colour printing-plates. The want of homogeneity of the colours is, as we have just said, a minor factor in the camera exposure. A colour negative possesses a distinct grain, which however is so soft that it altogether disappears in the half-tone reproduction, with the result that the three component pictures show completely even tones. In preparing these component negatives an enlargement up to 1½ times is possible, and in certain cases even up to twice, whilst still avoiding any injurious effect due to the structure of the colours in the original Autochrome or to any unsharpness of their outlines.[5]

Thus the black in an Autochrome forms no obstacle to its use in three-colour work, but this cannot be said of the slight and not always uniform saturation of the colours. The Autochrome may be compared with an original done in pale colours, whereas for three-colour work an original in strong colours is necessary. Each colour of the original, on account of its proportion of white light, acts through all three filters, and therefore the component negatives are very similar to each other, and the important differences which are necessary to obtain a print of strong colouring are absent. It is for this reason that the yellow is rendered so much further towards white. The yellow of the Autochrome plate also allows blue rays to pass, and will therefore be active in the exposure made with the blue filter, and be represented brighter than black. This fact can be clearly seen by making two photographs of (1) a colour chart and (2) its Autochrome photograph. Both exposures should be made with the ordinary plate and blue filter, and will thus represent the prints obtained in the yellow printing negative. Whilst in the negative from the original the yellow region will be shown as black, in that from the Autochrome it will be much too light. The three negatives from Autochromes thus show certain defects which do not exist in the case of exposures on the original, which defects are specially noticeable in the case of the yellow printing negative, the excessive whiteness of the yellow coming here into play. The results in the case of the red and blue are a great deal better. These defects may be to a very considerable extent improved by proper retouching of the printing plates, and perfectly satisfactory reproductions can be obtained by taking these measures. Still an easier, more ready, and less laborious process is that in which the three printing plates are obtained direct from the original, and it will, therefore, seem that the process operator will choose the method involving the Autochrome plate only when the original is not at his disposal, or when, as in the case of animal subjects or landscapes, the triple exposure cannot be made at all or only with considerable difficulty.

The above properties of the negatives prepared from Autochromes apply obviously to any other method of three-colour printing, such as pinatype, carbon, or diachrome, and, in fact, in these cases exerts a more disturbing effect, inasmuch as there is not the possibility of retouching.

In any case a great deal depends upon the perfection of the original Autochrome, and also equally upon the character of the original which it represents. Those originals with pronounced luminous colours without yellow easily lend themselves to three-colour reproduction, whilst originals of softly gradated colouring in which broken tones are in the majority will fall to be dealt with chiefly by the skilful fine-etcher and retoucher. For the diffused lighting of the original in the transparency-making camera a suitable artificial light can, of course, be employed, but steps must be taken to protect the original from overheating, and particular care needs to be given to this if the three negatives are being taken directly through the half-tone screen, inasmuch as in this case, on account of the slight transparency of the original, an intense lighting must be employed. The author has found that in such use of artificial light it is preferable to not varnish the negative, but to treat it with glycerine in order to avoid fracture of the film.

A. von Hübl.

SPOTS ON AUTOCHROMES.

Very frequently the black spots so common on Autochromes are attributed to faulty manufacture of the plates. While we fear there is little reason to doubt that this is often the true reason, yet a recent experience has proved to us that it is quite possible to produce exactly the same kind of spots by faulty manipulation. We had carried an Autochrome right up to the pre-intensification stage without mishap, and the result so far was very clean and free from spots, though rather thin. The intensifier was then mixed by mistake with tap water and applied to the plate. Naturally the solution was cloudy at the start, but in a few seconds it began to deposit heavy flakes of silver chloride all over the film, whereupon we immediately threw off the intensifier, washed the plate, treated it with permanganate, and then fixed it. The moment the fixing bath was applied the image began to lose density, and after washing we had to re-intensify with a properly mixed solution, but inspection after the first fixing showed that the plate was covered with black spots that of course did not improve in the second intensification. Apparently these spots were caused by the silver chloride, and therefore it seems that distilled water alone should be used for the intensifier. This has, of course, always been recommended, but we are inclined to think that many besides ourselves have sometimes used boiled or even tap water as a substitute. Another very prolific cause of spots is incomplete solution of the amidol in the redeveloper. We have traced many spots to this cause, and in consequence we have of late made a point of filtering this developer before use. Other spots can be caused by undissolved permanganate in the reversing bath, and various stains, as well as spots, have been found to be due to not rocking the dish during the reversing process. The use of a weak bath of plain acid sulphite before redevelopment is, we think, always a desirable precaution, for the positions of local permanganate stains in the reversed image are often rendered permanently visible in the redevelopment process.

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[3] "Zeitschrift für Reproductionstechnik," 1908, page 28.

[4] "Zeitschrift für Reproductionstechnik," 1908, page 31.

[5] In illustration of this point, Baron von Hübl gives a three-colour reproduction from an Autochrome transparency representing an enlargement of 1½ times. The original Autochrome and the component negatives are by G. Winter, and the half-tone blocks by the Graphische Union, Vienna. The reproduction certainly confirms the writer's description of it, namely, that the gradation is soft, the print sharp and full of detail.—Eds. "Colour Photography" Supplement.

Correspondence.

⁂ *We do not undertake responsibility for the opinions expressed by our correspondents.*

⁂ *Correspondents should never write on both sides of the paper. No notice is taken of communications unless the names and addresses of the writers are given.*

THE EXAMINATION OF THE POSITIVE OF THE "THAMES" COLOUR PLATE.

To the Editors.

Gentlemen,—As is now known, the colour screen and sensitive coating of this "one-exposure" colour plate are on separate glasses, and although it is the intention to put them on one, the present form gives opportunity to the user, without calling for any scientific knowledge, to study colour-screen photography, which will be impossible when both colour screen and emulsion are on the same glass support. The colour-screen has the three primary colours so arranged that the red and green take the form of circles, and the spaces between them, the interstices, are used for the blue, and as we shall see this difference in shape has an important bearing on the examination of the positive.

The colour-screen is put in contact and in front of the sensitive plate in the camera, and the latter is developed, reversed, redeveloped, and fixed, during which operation the colour screen is left in the dark slide or put in any other convenient place. We find in practice that the colour-screen in no way loses its power if the green circle is made slightly larger than the red. So we have a small red circle, a larger green circle, and a blue interstice. This variation at once gives an interesting and most useful means of examining the positive apart from the colour screen. For this, the user will require a magnifying glass; that called a "linen prover," sold for one shilling, is excellent for the purpose.

Let us take a case. A subject containing a variety of colours is photographed, and the plate carried through to its positive stage. The magnifying glass is now placed on the positive on a part which is known to be a blue vase. What ought to be seen is a clear interstice, with developed silver deposit on the circles as represented in fig. 1, the proportion of the circles to each other and their size being, of course, grossly exaggerated. In the same way the magnifier will show that the part of the positive which represents a yellow flower must have both circles clear, and the deposit on the interstice, fig. 2. Looking at the part which represents the red, it will be the smaller circle which is clear, and the larger circle and interstice both covered with deposit. The green will vary from this in that the large circle will be clear, and the small circle and interstice covered with deposit. The case of the yellow, which is not a primary, is typical of all colours obtained by the admixture of two or more primaries. A small clear circle (red) and a clear interstice (blue) will be needed to represent a violet, a clear large circle (green) and clear interstice (blue) means the colour will be light blue, or blue green.

All these instances have been taken where the colours used have been obtained by ringing the changes on the three pure primary colours.

It is an interesting fact that with this acquaintance with the variation in the formation of the colour patches, a person who had never seen the subject could not only give judgment on the correctness of a positive, but actually describe what colours the various parts will give when put up against the colour screen.

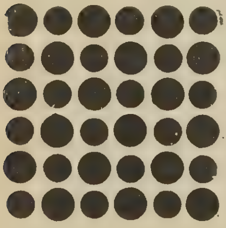

Fig. 1.

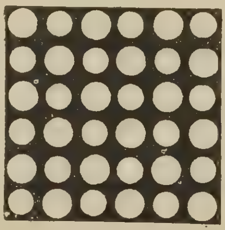

Fig. 2.

But what of the infinite variety of tints and tones other than the primaries, and of the lights and shades of a subject? Although more complicated these can also be analysed in the same way. It will be seen that not only is varying density playing its part, but that there is a variation in the area of the obscuring deposit. Shades of a green, for instance, may in some cases be obtained by a deposit of a certain density all over the green or by the deposit being denser, and in fact opaque, but not covering the entire area of the circle.

Apart from this analysis of the delicate half-tones, there is one broad principle which may be taken as a standard of a "Thames" screen-plate positive. It has been the failure to appreciate this that has been the cause of the few unsatisfactory results submitted to us, and we will now deal with it.

The positive should be as plucky, clean, and vigorous as a positive made by contact for a lantern slide in the usual way, and indeed, should only differ from it in that whereas in the latter case the deposit is continuous, in the former it is, *in the main*, minute islands of deposit in a sea of transparency.

The failure to get a plucky positive may be due to several causes, but generally is either (1) Over-exposure; (2) improper filter at the lens; or (3) over-redevelopment. As to (1), over-exposure in ordinary photography is by no means so troublesome as in the colour-screen photography. In the former it is the exposed, developed image which forms the picture. In colour-screen photography it is the reverse—*i.e.*, it is what is left that makes the image. If too much silver has been parted with in the first development and reversal, it is hopeless to expect a plucky image. The positive is a ghost and fails to fill its functions as a light-stopper when placed against the colour screen. (2) As to the improper filter, if it is too strong it damps the blue, making the plate too yellow, or if too weak, passes it unduly and makes it too blue. As to (3), over-redevelopment. Our sensitive plate is gelatine, which although much thinner than the usual emulsion, and, of course, panchromatic, will, after redevelopment, have something for the fixing bath to get rid of. As just after reversal and before the redevelopment the *whole* of the silver then remaining on the plate is exposed to and affected by light, if follows that if the *whole* of this is developed, the image may be too dense. It is quite easy to judge by looking through the plate during redevelopment when the image is about right and to stop at that, leaving the excess of silver to be cleared off in the fixing bath.

Oliver S. Dawson, Clare L. Finlay.

THE LIGHT FILTER IN AUTOCHROME PHOTOGRAPHY.

To the Editors.

Gentlemen,—The argument of "J. M." that it is not possible to get a correct focus by focussing through the screen placed behind the lens without other correction (the plate being reversed in the slide), appears plausible enough. Nevertheless, he must have failed to take into consideration some important influence in this question, for he has to face the fact that workers do focus correctly in this way.

Messrs. Lumière distinctly advise this method, stating that with cameras fitted with focussing scales, "the special taking screen should be used behind the lens, this screen being so calculated that when used behind the lens the necessary correction is produced." In my own experience with some dozens of Autochromes I have always focussed through the screen (behind the lens) and made no other allowance, and have always secured sharpness in the object I have focussed for. I have used two different cameras. I have heard of a worker focussing without the screen, and afterwards inserting the screen behind the lens. He secured an out-of-focus picture. I therefore see no probability of the plan leading "to a considerable waste of valuable plates," as "J. M." predicts.—Yours truly,

Alfred Watkins.

Hereford, November 20.

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Removing Black Spots from Autochromes.—In reference to the formula advised by Mr. T. K. Grant in his lecture before the Croydon Camera Club reported in our issue of November 20, we learn that the "Wellington" reducer there mentioned was not the thio-carbamide formula, but a fairly strong solution of iodine in potass iodide, made by dissolving 15 grains each of potass iodide and iodine in 2 ounces of water. This liquid is applied cautiously, followed by immersion in the hypo bath. We would add that in making up this solution some little difficulty may be found in getting the iodine to dissolve; the best method is to place the two chemicals in an empty measure, add just enough water to cover them—when the iodine instantly dissolves—and then add water to the total amount.

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